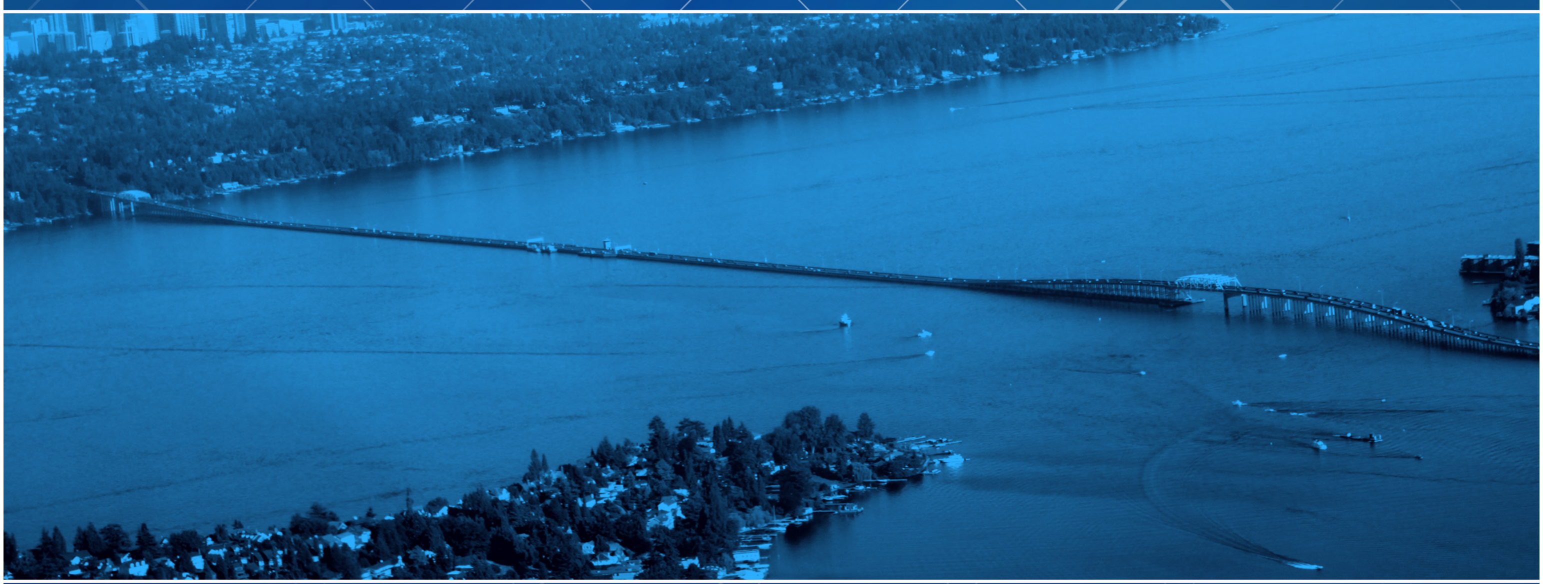
SR 520 Bridge Investment Grade Traffic and Revenue Study

Floating Bridge and Eastside Project



August 29, 2011

WilburSmith ASSOCIATES

Washington State Department of Transportation

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March 2011

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EXECUTIVE SUMMARY

The Washington State Department of Transportation (WSDOT) intends to toll the State Route 520 (SR 520) bridge between Seattle and Medina beginning in 2012.

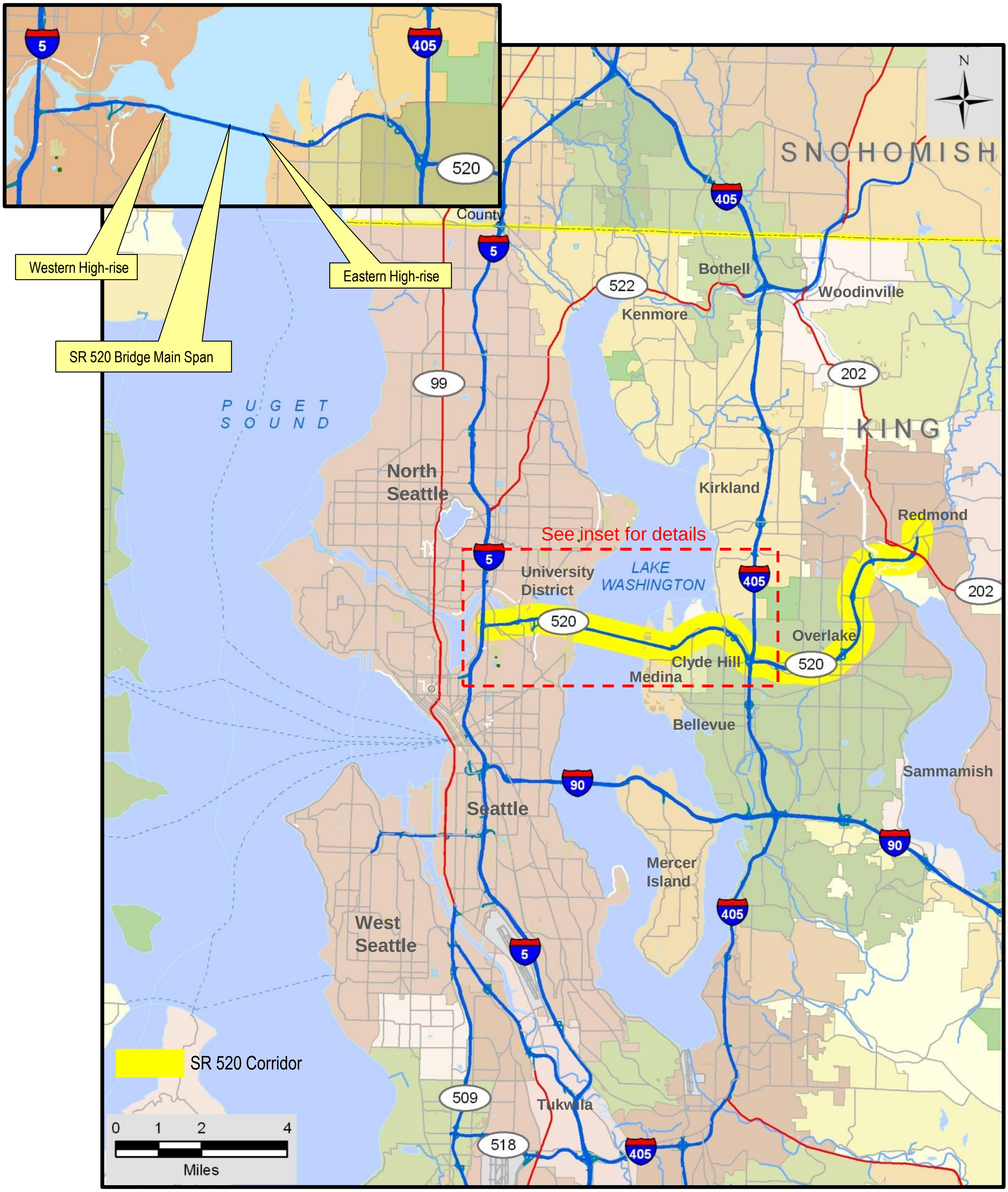
The SR 520 floating bridge opened to traffic in 1963. It was funded by tolls which were removed in 1979. WSDOT has studied replacing the bridge and its major approaches since the late 1990s. The bridge requires replacement due to damage sustained from heavy traffic, winds, and wave action. Originally designed to carry 65,000 vehicles per day, the bridge currently serves an average of approximately 100,000 vehicles per day. The average weekday traffic on the bridge exceeds 100,000 vehicles per day.

The toll revenue raised will be used to fund the replacement bridge and associated improvements in addition to ongoing operations and maintenance costs. Tolling will also be used to help manage congestion on the SR 520 corridor.

This report documents the investment grade traffic and revenue study conducted by Wilbur Smith Associates (WSA) that will be used for financing the SR 520 Floating Bridge and Eastside Project. The study was conducted at a level of detail sufficient for use in support of project financing. Traffic and revenue estimates are provided for FY 2012 through FY 2056.

PROJECT DESCRIPTION

SR 520 connects I-5 in Seattle on the west side of Lake Washington to the east side of Lake Washington, including downtown Bellevue (via I-405), Kirkland, and Redmond; all in King County. Figure ES-1 shows the corridor location. Seattle, Bellevue, and King County as a whole are all affluent areas. Based on 2009 U.S. Census Bureau data the household median income in King County is 35 percent above the U.S. average, Seattle 21



SR 520 CORRIDOR LOCATION

FIGURE ES-1

percent above, and Bellevue 64 percent above. Residential areas surrounding the SR 520 corridor have been in high demand continuously during the past several decades. Some of the densest housing in the region exists at the western terminus of the bridge, which includes the University of Washington, Downtown Seattle, and several central Seattle neighborhoods. The same can be said of the eastern portion of the SR 520 corridor which includes the cities of Kirkland, Bellevue, and Redmond. These cities all have high density and highly valued homes.

The total length of the SR 520 corridor is approximately 12.8 miles. The main SR 520 bridge span across Lake Washington is 1.4 miles long, making it the longest floating bridge span in the world. SR 520 is the northern of two east-west routes across Lake Washington. The average daily traffic based on WSDOT traffic counts is currently about 100,000. A significant component of its use is commuter traffic in both directions across the lake. I-90 also crosses Lake Washington with an average daily traffic of about 126,000. The traffic volumes on SR 520, the parallel I-90 route, and the two connecting interstates I-5 and I-405 are relatively stable throughout the year. SR 520 currently consists of:

- I-5 to the east side of Lake Washington (including the main bridge span): two general-purpose lanes in each direction
- Lake Washington to I-405: two general-purpose lanes in each direction and one westbound outside transit/high occupancy vehicle lane with a 3+ occupancy requirement (HOV3+)
- I-405 to SR 202 in Redmond: two general-purpose lanes in each direction and one outside transit/HOV lane in each direction with a 2+ occupancy requirement (HOV 2+)

The speed limit on SR 520 is 50 mph from I-5 across the bridge to the eastern side of Lake Washington. From there, it is 60 mph to nearly the corridor’s end in Redmond. The traffic profile of the bridge is relatively consistent between 7:00 am to 7:00 pm. Peak periods only have about 15 to 20 percent higher volume than the midday period. This difference in traffic volume though does impact bridge speeds. The SR 520 bridge often operates near the speed limit during off-peak periods. During peak periods, speeds sometimes slow to between 30 and 40 mph. Both eastbound and westbound traffic is subject to chokepoints just before the bridge. Congestion at these chokepoints can slow traffic to 15 to 30 mph and cause backups. The most severe congestion is experienced during the evening peak period in the westbound direction and traffic sometimes backs up past I-405. The bridge traffic level has been relatively stable during the last twenty years. The lack of traffic growth is a direct result of the bridge operating at or near capacity for much of the day.

For purposes of this study, the following improvements are included:

- Construction of a pontoon casting basin facility and replacement pontoons for use as the foundation of the new six-lane span
- New six-lane span (two general-purpose and one inside transit/HOV 3+ lane in each direction) from the west end of the main span across Lake Washington to the eastern shore landing
- Lake Washington to I-405: Addition of one eastbound lane from the eastern shore of Lake Washington to I-405 resulting in three lanes in each direction (two general-purpose and one transit/HOV 3+ lane in each direction) with HOV lanes relocated to the inside lanes
- I-405 to SR 202 in Redmond: Current configuration of two general-purpose lanes and one outside transit/HOV (HOV 2+) lane in each direction converted to two general-purpose lanes and one inside transit/HOV (HOV 3+) lane in each direction

Bridge replacement is needed since it is structurally deficient and functionally obsolete. The traffic and revenue forecasts provided herein do not account for reconstruction of the west end of SR 520 from I-5 to the west end of the main span. While plans to improve this section are in progress, they were not sufficiently developed and funded for inclusion in the study.

STUDY APPROACH

TRAVEL SURVEY

WSA conducted a travel survey of existing bridge users in September 2009. Based on nearly 6,000 acceptable responses, the survey results indicate:

- AM peak (6:00 to 9:00 am) travel and PM peak (3:00 to 6:00 pm) travel each account for approximately 18 percent of total trips; midday trips account for approximately 36 percent of total trips
- Trip purpose results show 85 percent of AM peak and 62 percent of PM peak trips are for work commuting; midday trips are dominated by company business, personal business/medical trips, and people going to jobs with later start times
- About half of all peak trips are made five times a week
- West end origins and destinations are almost all in Seattle, while east end origins and destinations are dominated by Bellevue, Redmond, and Kirkland

The results show the strong use of the SR 520 bridge for commuting in both directions across Lake Washington.

STATED PREFERENCE SURVEY

The WSA team conducted a stated preference survey in November 2009 to help assess current bridge users' willingness to pay tolls. This is measured in value of time, which is the monetary value an individual places on saving a certain increment of travel time. The survey also provided data to estimate changes in travel behavior in response to tolls. Changes in travel behavior include combining or forgoing trips, choosing a different destination, shifting to alternative modes including transit, and/or changes in the time of travel.

Value of time results from the 2009 stated preference survey were demonstrably lower than value of time results from a similar stated preference survey of SR 520 users in 2003. The survey results also revealed respondents have a relatively high median household income of about $125,000. While the range of values from the 2009 survey falls within the average range for the region estimated from other sources, the higher income of travelers in this corridor suggests that the value of time estimates should be higher than the regional average. Accordingly, analytical methods were used to re-benchmark value of time estimates to bring them into alignment with average hourly wages.

ECONOMIC GROWTH REVIEW

The State of Washington and Puget Sound region have been impacted by the severe national recession which began in 2008. Consequently, the impact of the recession on future socioeconomic activity was evaluated through an independent economic assessment. The WSA team examined multiple regional forecasts, detailed real-estate and employment activity, and area growth plans to update the Puget Sound Regional Council's (PSRC) forecast to account for the recession and current activity.

Based on independent economic forecasts incorporating the downturn, employment in the Puget Sound region is expected to grow from 1.77 million in 2010 to 2.70 million in 2040, equivalent to an annual increase of 31,000 or a 1.4 percent annual growth rate. The region's population is expected to grow from 3.68 million to 4.91 million over the same time period, or about 41,000 annually, yielding a one percent annual growth rate.

Since the economic forecasts for the study were completed, new regional forecasts have become available. The economic growth forecasts used in this analysis relied on a Conway Pedersen forecast published in September

2010. For comparative purposes the June 2011 Conway Pedersen forecasts show a slower economic recovery. Regional employment forecasts for 2016 are 2.8 percent lower in the June 2011 forecast than the September 2010 forecast. Regional population forecasts for 2016 are only 0.5 percent lower.

TOLLING OPERATIONS

WSDOT reviewed many alternative scenarios in the process of developing a selected tolling scenario. WSDOT has chosen to implement a variably-priced, all electronic, cashless tolling system on the SR 520 bridge. This will allow all vehicles to travel through the corridor at highway speeds without stopping to pay the toll. Variable pricing will allow for better management of the facility's traffic operation throughout the day.

When the existing SR 520 bridge is tolled, the tolling point will be at the east high-rise section of the bridge. Following replacement of the bridge, the tolling point will move to the eastern shore. Tolls will be collected in both directions via transponder and video collection systems. Transponder toll collection will be conducted using WSDOT's Good to Go! passes. SR 520 users who do not have a Good to Go! pass will be tolled by capturing their vehicle license plates using cameras. From February 2011 (when WSDOT began offering new transponders for sale) through June 2011, approximately 135,000 new transponders have been issued.

Users will have two primary ways of paying their toll:

- Account-based, either via transponders or registered license plates linked to a prepaid account
- Pay-by-Mail, in which unregistered video toll users will have a bill mailed to them after using the facility

Initial (FY 2012) Account-based passenger car toll rates will range from \$1.60 during off-peak times to \$3.50 during peak times in each direction on weekdays. Initial weekend base tolls will vary from \$1.10 to \$2.20. Due to costs associated with different types of toll payment, users who do not use an Account-based transaction will pay an additional \$1.50 per transaction. Tolls will not be collected between 11:00 pm and 5:00 am during bridge construction, assumed to be through FY 2016. Beginning in FY 2017, tolls are assumed to be collected 24 hours a day. Tolls are assumed to increase by 2.5 percent annually each July 1 beginning on July 1, 2012 through and including July 1, 2015. On July 1, 2016, weekday tolls are assumed to increase by 15 percent on average and weekend tolls by 2.5 percent, then remain at these levels with no further increases throughout the rest of the forecast horizon. This results in toll rates decreasing in real dollar terms after 2017.

Vehicles will be tolled on the SR 520 bridge according to vehicle classes by number of axles. These are:

- 2 Axles – including motorcycles and two-axle – six-tire vehicles
- 3 Axles – any combination including two-axle vehicles towing one-axle trailers
- 4 Axles – any combination of four axles
- 5 Axles – any combination of five axles
- 6 or more Axles – any combination of six or more axles

The toll rates for multi-axle vehicles will be determined by multiplying the number of axles by the per-axle toll rate for two-axle vehicles using the same payment method. It is assumed that, beginning in FY 2017, HOV 3+ vehicles will not be tolled.

TRAFFIC AND GROSS REVENUE MODELING APPROACH

WSA's process for estimating traffic and revenue for the SR 520 bridge can be summarized by the following major steps:

- The regional travel demand model from the Puget Sound Regional Council was acquired.
- Information from additional data collection efforts such as the travel survey, stated preference survey, truck counts, and the economic growth review were incorporated to enhance the model.
- Specific parameters, algorithms, and equations were incorporated into the modeling process for value of time, trip suppression, mode shift, and traveling to avoid peak times in response to tolling.
- Average weekdays for key years (FY 2012, FY 2016, FY 2017, FY 2024, FY 2031, and FY 2056) were modeled in detail for the assumed toll rate structure.
- Average weekday daily traffic and revenue was calculated from the modeling results.
- Average weekday traffic and revenue was converted to annual traffic for the key model years. This step included accounting for weekends and holidays.
- The traffic and revenue stream estimate between FY 2012 and FY 2056 was generated by interpolation between model years.

- The construction program was reviewed to identify impacts resulting in lane closures and adjustments were applied. A factor was applied to reflect the short term adjustment to new tolling (termed "ramp-up").

MAJOR ASSUMPTIONS

Table ES-1 summarizes the major assumptions made in this study.

Table ES-1
Major Assumptions

Category	Assumptions
General Assumptions	Improvements in the Puget Sound Regional Council's current regional transportation plan, *Transportation 2040* , will be implemented as planned. No new competitive toll-free facilities or additional capacity will be constructed during the projection period other than those assumed in the plan.
	The percentage of payment types will be consistent with the ranges assumed for this study. The percentage of potential bridge users in the Account-based program is assumed to increase from 62.5 percent in FY 2012 to 85 percent in FY 2031.
	Economic growth in the project study area will occur as forecasted herein based in part on forecasts from the Puget Sound Regional Council and the September 2010 Conway Pederson forecasts.
	The facility will be well maintained, efficiently operated, effectively signed, and promoted to encourage maximum usage.
	Inflation will average 2.5 percent per year.
	Motor fuel will remain in adequate supply and no national or regional emergency will arise that would abnormally restrict the use of motor vehicles. The per-gallon price for passenger car fuel is assumed at $3.86 in FY 2012. Through FY 2027 it is assumed to increase in accordance with the June 2011 WSDOT Transportation Economic and Revenue Forecasts report and by 2.5 percent thereafter.
	The value of time for work trips ranges from $9.60 per hour for the lowest income group to $22.80 per hour for the highest income group. The value of time for non-work passenger car trips is $13.80 per hour. Truck trip value of time reaches $36.00 per hour for heavy trucks. All values are in 2010 dollars.
Bridge Configuration	FY 2012 - FY 2016: Two narrow general-purpose lanes and shoulders in each direction.
	FY 2017 and onward: Two wider general-purpose lanes in each direction, one HOV/transit lane (with three person occupancy requirement HOV3+) in each direction, and wider shoulders in each direction on the new span. This configuration will connect back to the existing two general-purpose lanes in each direction west of the new western high-rise.
SR 520 Configuration East of Bridge to I-405	FY 2012 - FY 2016: Two general-purpose lanes in each direction and one outside HOV lane (with three person occupancy requirement HOV3+) westbound as exists currently.
	FY 2017 and onward: Two general-purpose lanes in each direction and one inside HOV/transit lane in each direction (with three person occupancy requirement HOV3+).
Toll Collection	Tolls will be collected at a single point on the eastern high-rise of the main span while traffic remains on the existing bridge and at a single point on the eastern shore when traffic moves to the new bridge.
	Toll rates will be the same for either direction on the bridge.
	The toll collection is all electronic; there will be no manual toll collection.
	FY 2012 - FY 2016: no night time tolling (11pm - 5am).
	FY 2017 and beyond: tolls will be charged during all 24 hours.

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Table ES-1 (Continued from previous page)

Toll Rates	**FY 2012 - FY 2016**
	Tolling commences on January 1, 2012.
	The maximum initial Account-based toll rate for two-axle vehicles will be $3.50 on weekdays and $2.20 on weekends.
	At the beginning of FY 2013 and for each subsequent year through FY 2016 (i.e., on July 1 of 2012, 2013, 2014, and 2015) both weekday and weekend Account-based tolls will increase by 2.5 percent on average.
	In FY 2012, Pay-by-Mail customers will pay a $1.50 differential above the Account-based toll rates. At the beginning of each subsequent fiscal year (FY 2013 through FY 2016), the differential for Pay-by-Mail customers will escalate by 2.5 percent.
	High occupancy vehicles (HOVs) will pay the same toll as single-occupant vehicles (SOVs).
	Toll exemptions as outlined by the Washington State Transportation Commission (the largest of which is the transit buses, private regular route buses such as the Microsoft Connector, and WSDOT sanctioned vanpools) are assumed.
	Tolls for multi-axle vehicles (those with more than two axles on the ground) will be determined by multiplying the number of axles by the per-axle toll rate for two-axle vehicles using the same payment method. Consequently, in FY 2012, Pay-by-Mail customers will be paying a $0.75 per-axle differential above the Account-based toll rates.
	FY 2017 and beyond
	Weekday Account-based tolls will increase on average approximately 15 percent from FY 2016 to FY 2017 (i.e., on July 1, 2016).
	Weekend Account-based tolls will increase approximately 2.5 percent on average from FY 2016 to FY 2017 (i.e., on July 1, 2016).
	The Pay-by-Mail toll differential will increase 2.5 percent from FY 2016 to FY 2017 (i.e., on July 1, 2016).
	Toll exemptions as noted above are continued.
	HOVs with three or more occupants will be exempt from paying tolls; HOVs with two occupants will pay the same toll as SOVs.
	Tolls for multi-axle vehicles will be based on the number of axles as noted above.
	No toll rate escalation is assumed after FY 2017.
Construction Closures	Full weekend closure of SR 520 from the Montlake Interchange to I-405 including the tolled section will occur four times in the last half of FY 2012, five times in FY 2013, four times in FY 2014, and two times in FY 2015. Closure will be from 11 PM on Friday to 5 AM on Monday.
Ramp-Up	Annualized traffic was adjusted downwards to 95% to reflect ramp-up in FY 2012 and to 97% in FY 2013 to take into account possible initial resistance to tolling a facility that has been free since 1979.

TRAFFIC AND GROSS REVENUE RESULTS

The toll transactions and revenue forecast for the selected investment grade baseline scenario is shown in Table ES-2. Transactions are the number of tolled vehicles passing through the toll collection point. Toll revenue estimates presented are gross revenue; the revenue that would result if each vehicle passing through the toll collection point paid exactly the published toll rate based on the vehicle's classification, time of day, and toll payment method (Account-based or Pay-by-Mail). Gross revenue does not include the effects of fees or discounts, overpayments, underpayments, uncollectable tolls, and/or toll evasion. No analysis of these toll variance factors is included in this report. Toll variance factors are considered in the "SR 520 Bridge Net Toll Revenue Report."

The toll rates anticipated are less than the toll rates that would maximize toll revenue. For example, the initial peak period toll rate of $3.50 for passenger cars is estimated to generate revenue equal to 88 percent and 91 percent of the maximum revenue during the AM and PM peak periods respectively. In FY 2017, peak toll rates are estimated to generate 80 and 76 percent of the maximum revenue during the AM and PM peak periods, respectively.

Tolling on SR 520 is expected to result in significant diversions of traffic to I-90 and other alternative routes. Off-peak diversions will be greater percentage-wise than peak diversions because of additional available capacity on alternative routes during off-peak periods. Figure ES-2 shows the historical and forecasted average annual daily traffic on the SR 520 bridge. Traffic on the bridge is expected to decline by approximately 48 percent in 2012 as a result of the imposition of tolling.

The traffic diversion from SR 520 as a result of tolling is estimated to make available roadway capacity for future growth. This study assumes no improvements to SR 520 from I-5 to the curve before the western high-rise once construction is complete. Intuitively, this may indicate that the current westbound chokepoint just before the main bridge span will be replaced by a similar chokepoint just west of the western high-rise. However, the effect of tolls on SR 520 traffic is anticipated to lower SR 520 travel demand to a level which would allow free flow operation through this transitional section. The traffic diversion impacts associated with the imposition of tolling will be at their "worst" soon following the commencement of tolling. In future years, as congestion levels on all facilities continue to increase, the competitive position of the SR 520 bridge will gradually improve. Steady annual traffic increases on SR 520 are forecast; however, traffic is not expected to return to current levels until 2032.

Table ES-2

Projected Toll Transactions and Revenue (in millions of year of collection dollars) on SR 520 (FY 2012-2056)

Fiscal Year	Total Transactions	Transactions Growth %	Total Gross Revenue	Gross Revenue Growth %
2012	8.659		$ 27.840	
2013	18.973		61.810	
2014	20.968	10.5%	69.390	12.3%
2015	22.455	7.1%	75.510	8.8%
2016	23.960	6.7%	81.920	8.5%
2017	23.618	-1.4%	87.640	7.0%
2018	24.475	3.6%	89.830	2.5%
2019	25.333	3.5%	92.080	2.5%
2020	26.190	3.4%	94.390	2.5%
2021	27.048	3.3%	96.760	2.5%
2022	27.905	3.2%	99.180	2.5%
2023	28.763	3.1%	101.670	2.5%
2024	29.620	3.0%	104.210	2.5%
2025	30.263	2.2%	106.360	2.1%
2026	30.906	2.1%	108.550	2.1%
2027	31.549	2.1%	110.780	2.1%
2028	32.192	2.0%	113.060	2.1%
2029	32.835	2.0%	115.380	2.1%
2030	33.478	2.0%	117.740	2.0%
2031	34.121	1.9%	120.150	2.0%
2032	34.804	2.0%	122.520	2.0%
2033	35.427	1.8%	124.660	1.7%
2034	35.986	1.6%	126.570	1.5%
2035	36.481	1.4%	128.260	1.3%
2036	36.907	1.2%	129.710	1.1%
2037	37.264	1.0%	130.900	0.9%
2038	37.551	0.8%	131.860	0.7%
2039	37.765	0.6%	132.560	0.5%
2040	37.907	0.4%	133.000	0.3%
2041	38.049	0.4%	133.450	0.3%
2042	38.192	0.4%	133.900	0.3%
2043	38.336	0.4%	134.350	0.3%
2044	38.480	0.4%	134.800	0.3%
2045	38.625	0.4%	135.250	0.3%
2046	38.771	0.4%	135.710	0.3%
2047	38.918	0.4%	136.170	0.3%
2048	39.064	0.4%	136.620	0.3%
2049	39.213	0.4%	137.090	0.3%
2050	39.361	0.4%	137.550	0.3%
2051	39.509	0.4%	138.020	0.3%
2052	39.659	0.4%	138.490	0.3%
2053	39.810	0.4%	138.950	0.3%
2054	39.961	0.4%	139.430	0.3%
2055	40.113	0.4%	139.900	0.3%
2056	40.265	0.4%	140.380	0.3%

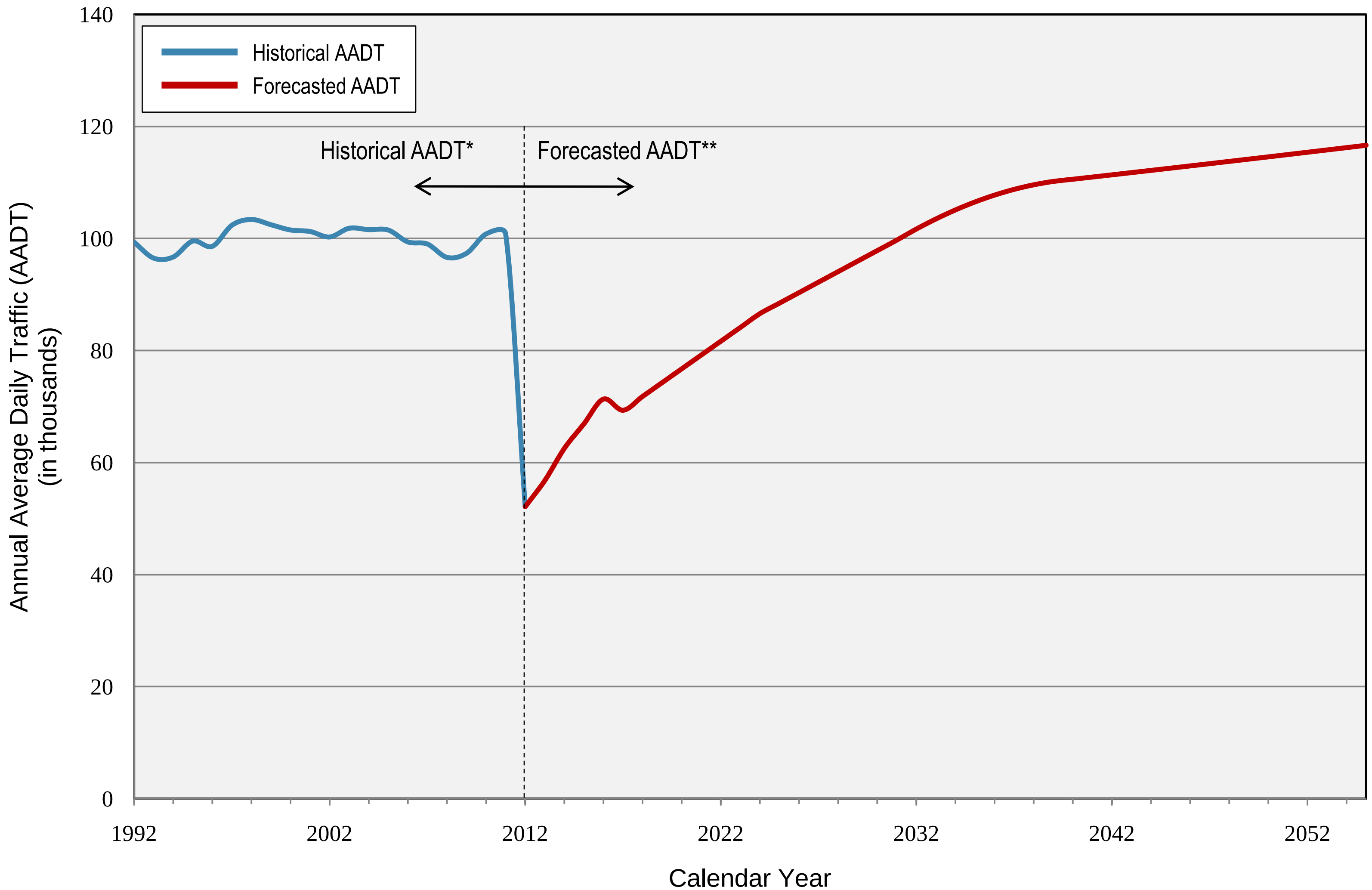
Notes:

Transactions are the number of tolled vehicles passing through the toll collection point.

Tolling is assumed to start on January 1, 2012; FY 2012 numbers are for 6 months only.

Ramp-up is assumed at 95% for FY 2012, 97% for FY 2013, 100% in FY 2014+.

Transactions are intended to be used for revenue estimation only.



* Historical AADT: WSDOT Annual Traffic Data Reports
** Forecast AADT: T&R Analysis

HISTORICAL AND FORECASTED SR 520 ANNUAL AVERAGE DAILY TRAFFIC

FIGURE ES-2

The improved facility will increase the effective capacity of the Lake Washington crossing after 2017. Along with the additional HOV lane in each direction, lane widths and shoulder width improvements will increase the effective operating capacity of the two general-purpose lanes in each direction allowing traffic to grow beyond current levels in the long term.

Estimated annual gross revenue is $27.8 million for the last six months of FY 2012 increasing to $87.6 million by the assumed completion date of the bridge in FY 2017, to $104.2 million in FY 2024, and $120.1 million in FY 2031. Estimated revenues increase by approximately 40 percent during the construction and ramp-up period from the first full year of operation to the assumed completion date of FY 2017, reflecting an increase in traffic and toll rates over this period. With unchanged toll rates thereafter, gross revenue growth is expected to grow at an annual rate of 2.5 percent immediately after FY 2017 declining to an annual growth rate of about one percent in FY 2036 and further declining to an annual growth rate of less than one percent thereafter.

In estimating the revenue potential of the SR 520 bridge, it is incumbent on the State to make prudent assumptions that will not overstate revenue receipts. Because of this goal, traffic forecasts in this evaluation are lower than those used for the SR 520 bridge replacement National Environmental Policy Act (NEPA) process and for operational planning purposes. However, a strict comparison cannot be made because of differences in underlying assumptions. For the NEPA environmental studies, the project team must make assumptions that will not understate traffic and its impact on the environment. Traffic volumes in this report are solely intended for the purposes of developing appropriate revenue forecasts for project financing purposes and are not intended to replace the SR 520 NEPA analysis results.

SENSITIVITY TESTS

In order to ascertain the impact of possible changes in input parameters and their effect on traffic and revenue, several sensitivity tests were performed. The assumptions chosen for the tests are those that present risks because they are subject to variability and potentially impact the revenue estimate. Variation in the following parameters and assumptions were tested:

- Regional growth
- Value of time
- Account-based participation rate

- Motor fuel cost
- Trip suppression and mode shift
- Possible tolling of the I-90 bridge

The results of all the sensitivity tests for the key years of FY 2012, FY 2017, FY 2024, and FY 2031 are shown below in Table ES-3. Highlights of the results are described in the following sections:

REGIONAL GROWTH

The regional growth sensitivity test concluded that long-term revenue potential on SR 520 is not materially dependent on future economic growth in the region. While some economic growth is anticipated, this growth accounts for a relatively small share of future revenue. For example, if there were essentially no economic growth in the Puget Sound region for at least the next two decades, revenue would reduce by less than 30 percent, even in the year 2031. This suggests that less than 30 percent of the future revenue potential is directly attributable to future economic growth.

From the standpoint of revenue risk, this is a positive indication. In general, economic growth forecasts are among the most significant areas of uncertainty in the traffic and revenue forecasting process. The higher the dependence on future economic growth, the higher the long-term risk to the forecast. In this case, since the facility has such a strong, well-established pattern of existing use, it is less dependent on future economic growth than most other new toll facilities which inherently reduces the magnitude of risk associated with this important factor.

VALUE OF TIME

The purpose of this test was to quantify the revenue impact of the actual value of time being different from what was used in the study. The value of time is important to the revenue forecast but can be difficult to quantify. The test evaluated values of time 20 percent lower and higher than the value of time used in the baseline analysis. The 20 percent variation is somewhat arbitrary but is consistent with other studies.

FY 2012 presents the biggest difference compared to the baseline scenario. As time goes on, the forecast effect of lower or higher value of time declines. A 20 percent lower value of time in FY 2012 causes an 11.2 percent decrease in revenue. This decreases to a 3.4 percent decrease in revenue by FY 2031. The effect of the value of time difference in the future is less because increased network congestion makes alternatives to the tolled SR 520 bridge less viable and the real dollar value of the toll declines after FY 2017.

Table ES-3
Summary of Sensitivity Test Results for Revenue -
FY 2012, FY 2017, FY 2024 and FY 2031
(Revenue in millions of year of collection dollars)

Sensitivity Test	Percent Change in Gross Revenue from Baseline Scenario			
	FY 2012	FY 2017	FY 2024	FY 2031
Regional Growth:				
No Growth	n/a	-24.1%	-24.7%	-29.1%
Low Growth	n/a	-11.4%	-12.0%	-13.9%
High Growth	n/a	12.9%	16.0%	18.0%
Value of Time (VOT):				
20% Higher VOT	8.2%	5.9%	3.8%	2.2%
20% Lower VOT	-11.2%	-7.9%	-5.9%	-3.4%
Account-based Participation Rate:				
20% Higher Acct.-based	-2.2%	-3.5%	-5.0%	-5.6%
20% Lower Acct.-based	2.4%	4.0%	5.1%	6.6%
Motor Fuel Cost:				
50% Higher Fuel Cost	-4.3%	-4.1%	-5.1%	-5.3%
Trip Suppression and Mode Shift:				
Higher Suppression	-3.4%	-2.5%	-2.4%	-1.3%
No Suppression	4.1%	3.6%	2.6%	2.0%
Possible Tolling of I-90 Bridge:				
I-90 Tolled*	38.1%	26.3%	18.0%	9.6%

*includes impact on SR 520 revenue only

ACCOUNT-BASED PARTICIPATION RATE

This test examined the impact on traffic and revenue of Account-based transaction participation rates differing from that assumed in the baseline scenario. The baseline scenario assumes that in FY 2012, 62.5 percent of the potential SR 520 bridge users participate in the Account-based system by either having a transponder or pre-registering their license plate. The high and low sensitivity tests evaluated a change of plus and minus 20 percent (i.e., 75 and 50 percent of the potential SR 520 bridge users) of the potential users utilizing the Account-based system.

A plus and minus change of 20 percent in the Account-based participation rate affects FY 2012 revenue results by slightly more than two percent. Note, there is a $1.50 additional charge for non Account-based passenger car transactions. The compensating effects with higher Account-based participation are more transactions; the effective toll rate is lower for a greater number of people, but the revenue per transaction is lower resulting in a negligible difference in expected revenue. The effect is the same in reverse for a lower Account-based participation percentage. With lower participation, the revenue difference from the baseline increases in future years but is always less than seven percent. In this case, there are fewer transactions due to the higher average toll but more revenue collected due to the differential paid by Pay-by-Mail users.

MOTOR FUEL COST

A base assumption is that FY 2012 fuel costs will be $3.86 per gallon ($3.77 in 2010 dollars). A test evaluating a 50 percent increase in fuel cost results in a FY 2012 fuel cost of $5.79 ($5.66 in 2010 dollars). Higher fuel prices reduce overall demand but also make additional travel distance in order to avoid a toll less attractive. Both these effects are taken into account.

The results vary by year but are in the range of a four to five percent decrease in revenue. Noting that the test involves a 50 percent increase in fuel price, this test could be seen as a reasonable upper limit on what might be expected due to fuel price escalation.

TRIP SUPPRESSION AND MODE SHIFT

Among the travel parameters modeled in this study, one is the response to tolling of SR 520 users in terms of their trip-making characteristics. The tolling model sensitivity to these changes is based on the stated preference survey in terms of trips cancelled, destinations changed, trips combined together, or trips shifted to transit.

One sensitivity test approximately doubled the percentage of trips suppressed compared to the baseline case while another test assumed no suppression at all. Test results indicate relatively modest revenue impacts with higher suppression in FY 2012 lowering revenue by 3.4 percent and no suppression increasing revenue by 4.1 percent. The effects in outer years are less. Thus, with the range tested, suppression is not an important consideration.

POSSIBLE TOLLING OF THE I-90 BRIDGE

A test was performed in which the I-90 bridge across Lake Washington was tolled at exactly the same rates assumed for the SR 520 bridge tolling. As expected, the tolling of I-90 bridge has substantial positive benefits on SR 520 revenue particularly in the early years. For FY 2012, the increased revenue is about 38 percent, which will decline to slightly less than 10 percent by FY 2031. Note, the revenue changes are for SR 520 revenue only; the results presented do not include revenue from I-90.

CHAPTER 1

INTRODUCTION

The Washington State Department of Transportation (WSDOT) intends to toll the State Route 520 (SR 520) bridge between Seattle and Medina, Washington beginning in 2012.

The SR 520 floating bridge opened to traffic in 1963. WSDOT has studied replacing the bridge and its major approaches since the late 1990s. The bridge requires replacement due to damage sustained from heavy traffic, winds, and wave action. Originally designed to carry 65,000 vehicles per day, the bridge currently serves an average of approximately 100,000 vehicles per day. The average weekday traffic on the bridge exceeds 100,000 vehicles per day.

The toll revenue raised will be used to fund three projects:

- Construction of a pontoon casting basin facility and replacement pontoons at that site
- Transit and high occupancy vehicle (HOV) lane improvements from the vicinity of the SR 520 main bridge western high-rise to SR 202 in Redmond
- Constructing and installing the new SR 520 floating bridge and landings

Tolling will also be used to help manage congestion on the SR 520 corridor.

This report documents the traffic and revenue study conducted by Wilbur Smith Associates (WSA) that will be used for financing the SR 520 bridge project. The study was conducted at a level of detail sufficient for use in support of project financing. WSA collected available model datasets and performed several surveys and studies to develop a traffic forecasting model used for the analysis of tolling scenarios. Details of the forecasting process and results are provided in subsequent chapters of this report. This study was conducted independently of previous environmental studies of the SR 520 bridge project.

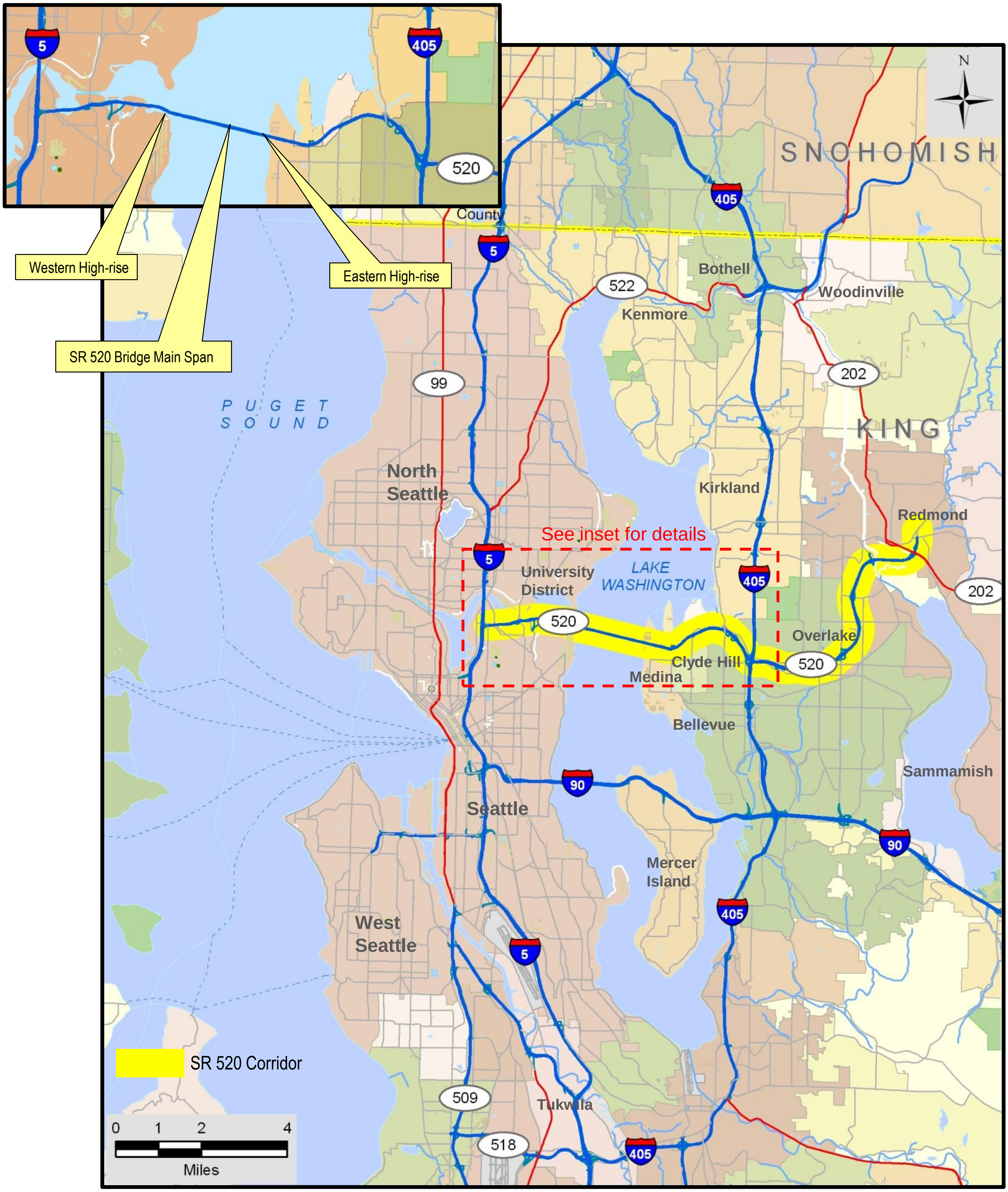
In estimating the revenue potential of the SR 520 bridge, it is incumbent on the State to make prudent assumptions that will not overstate revenue receipts. Because of this goal, traffic forecasts in this evaluation are lower than those used for the SR 520 bridge replacement National Environmental Policy Act (NEPA) process and for operational planning purposes. However, a strict comparison cannot be made because of differences in underlying assumptions. For the NEPA environmental studies, the project team must make assumptions that will not understate traffic and its impact on the environment. Traffic volumes in this report are solely intended for the purposes of developing appropriate revenue forecasts for project financing purposes and are not intended to replace the SR 520 NEPA analysis results.

PROJECT DESCRIPTION

GENERAL

Figure 1-1 depicts the SR 520 corridor location and its relationship to the surrounding transportation system. SR 520 connects I-5 in Seattle to the east side of Lake Washington, downtown Bellevue (via I-405), and beyond to Redmond, WA. The total length of the SR 520 corridor is approximately 12.8 miles. It is access-controlled throughout its length. SR 520 includes a floating bridge which spans Lake Washington. To the west of the lake, SR 520 consists of additional bridges and surface sections including the Montlake Boulevard Interchange near the University of Washington and the I-5 interchange approach. To the east of the lake, SR 520 is mostly composed of surface sections and has several interchanges with local arterials as well as I-405 and finally SR 202 in Redmond.

The SR 520 floating bridge, formally known as the Governor Albert D. Rosellini Bridge – Evergreen Point, was constructed in the 1960s and opened to traffic in August 1963. The main bridge span is 1.4 miles long and is the longest floating bridge span in the world. It consists of 33 pontoons each approximately 360 feet long. The bridge roadway consists of two narrow general-purpose traffic lanes in each direction, a center barrier, and small shoulders on either side of both travel directions. The speed limit on the bridge is 50 mph. High-rise bridges on either end of the floating span provide for passage of boats. A center articulated section can open for exceptionally tall watercraft, but is generally designed to open to relieve water pressure on the bridge during major wind events. The floating bridge is closed to traffic when wind gusts reach 50 mph or more for 15



SR 520 CORRIDOR LOCATION

FIGURE 1-1

minutes or more. Fixed single-point tolls were collected on the east bridge approach from its opening until 1979.

WSDOT has studied replacing the bridge and its major approaches since the late 1990s. The bridge has been damaged by heavy traffic, wind, and wave action over its history and needs replacement. The SR 520 bridge was designed to carry 65,000 vehicles per day but currently carries an annual average daily traffic of about 100,000 and average weekday traffic of over 100,000 vehicles. Major residential and commercial developments exist on both sides of the bridge, frequently resulting in congestion in both directions during morning and evening peak periods on weekdays and on many weekends. In addition to regular vehicular traffic, SR 520 serves many cross-lake bus routes and includes transit features such as freeway transit stops and transit/HOV lanes in some sections. However, no HOV lanes currently exist on the SR 520 floating bridge span (HOV lanes are designated for those traveling with more than one person in a vehicle. In the case of SR 520, the minimum occupancy requirements vary by the section of HOV lane being used. In addition, the State of Washington permits transit agency vehicles to use the HOV lanes, regardless of the number of occupants).

A second floating bridge across Lake Washington, located on I-90 south of SR 520, connects I-5 and I-405. The I-90 bridge is the primary alternative to the SR 520 bridge. The I-90 bridge provides three general-purpose travel lanes in each direction as well as two reversible HOV lanes. This route also provides a multi-use non-motorized path across the bridge. The regional transit authority, Sound Transit, plans to expand its light rail system from downtown Seattle across the I-90 bridge to downtown Bellevue and to the Overlake region of Redmond by 2023. While this project will involve removing the two reversible lanes, WSDOT will be restriping the existing three-lane section and shoulders in each direction to provide a four-lane section in each direction. The ultimate configuration will have three general-purpose traffic lanes and one transit/HOV lane in each direction.

Although they do not directly cross Lake Washington, other competing routes to the SR 520 bridge include I-405 north and south of the lake, as well as SR 522 which is a local arterial around the north end of the lake as shown in Figure 1-1.

SR 520 Long Term Plan

The long term, $4.65 billion plan for the **SR 520 Floating Bridge Replacement and HOV Program** includes the following improvements:

- **The Floating Bridge and Landings Project**
  - Floating bridge replacement (including high-rise bridges and the addition of transit/HOV lanes and non-motorized path)
  - Interim connection to the West Approach bridge.
- **The Eastside Project**
  - Move existing westbound HOV lane to center of roadway
  - Construct eastbound HOV lane at center of roadway (Medina to I-405) and move eastbound HOV lane to center of roadway (I-405 to SR 202)
  - Construct landscaped and roadway lids over SR 520 at three key locations
  - Construct two median transit stops at Evergreen Point Road and 92nd Avenue NE
  - Construct direct access transit/HOV ramps at 108th Avenue NE
- **The Pontoon Construction Project**
  - Construct emergency replacement pontoons
  - Use emergency pontoons to build new bridge span
- **The Westside Project**
  - I-5 interchange improvements including reversible direct-access transit/HOV to I-5 reversible lanes
  - Portage Bay Bridge replacement
  - Montlake interchange improvements including reversible direct-access transit/HOV ramps
  - West approach replacement

- **Not a part of the $4.65B SR 520 Floating Bridge Replacement and HOV Program but important to toll implementation:**
  - Lake Washington Congestion Management Project
    - Tolling of SR 520
    - Active Traffic Management on I-90 and SR 520 bridges
    - Travel time signs
    - Transit service increases
    - Telecommuting promotion

SR 520 TOLLING PROJECT

The approximately $2.432 billion project which is the subject of this traffic and revenue study includes the replacement of the SR 520 main span, high-rise bridges, landings, a pontoon construction facility, pontoons at that facility, and the Medina-to-SR 202 Eastside Transit and HOV Project. It does not include any improvements from I-5 to the curve before the western high-rise.

The replacement SR 520 bridge span will be located slightly to the north of the current span, allowing the majority of its construction to take place without interrupting traffic on the existing span. The new span will include an additional lane in each direction, slightly wider lane widths, significantly wider shoulders, and a non-motorized multi-use path on the north side. The roadway travel directions will be separated by a median barrier. A second barrier will separate the multi-use path from the main roadway.

The following sections outline the assumptions made regarding the construction schedule and roadway configuration in developing toll revenue forecasts for the SR 520 project.

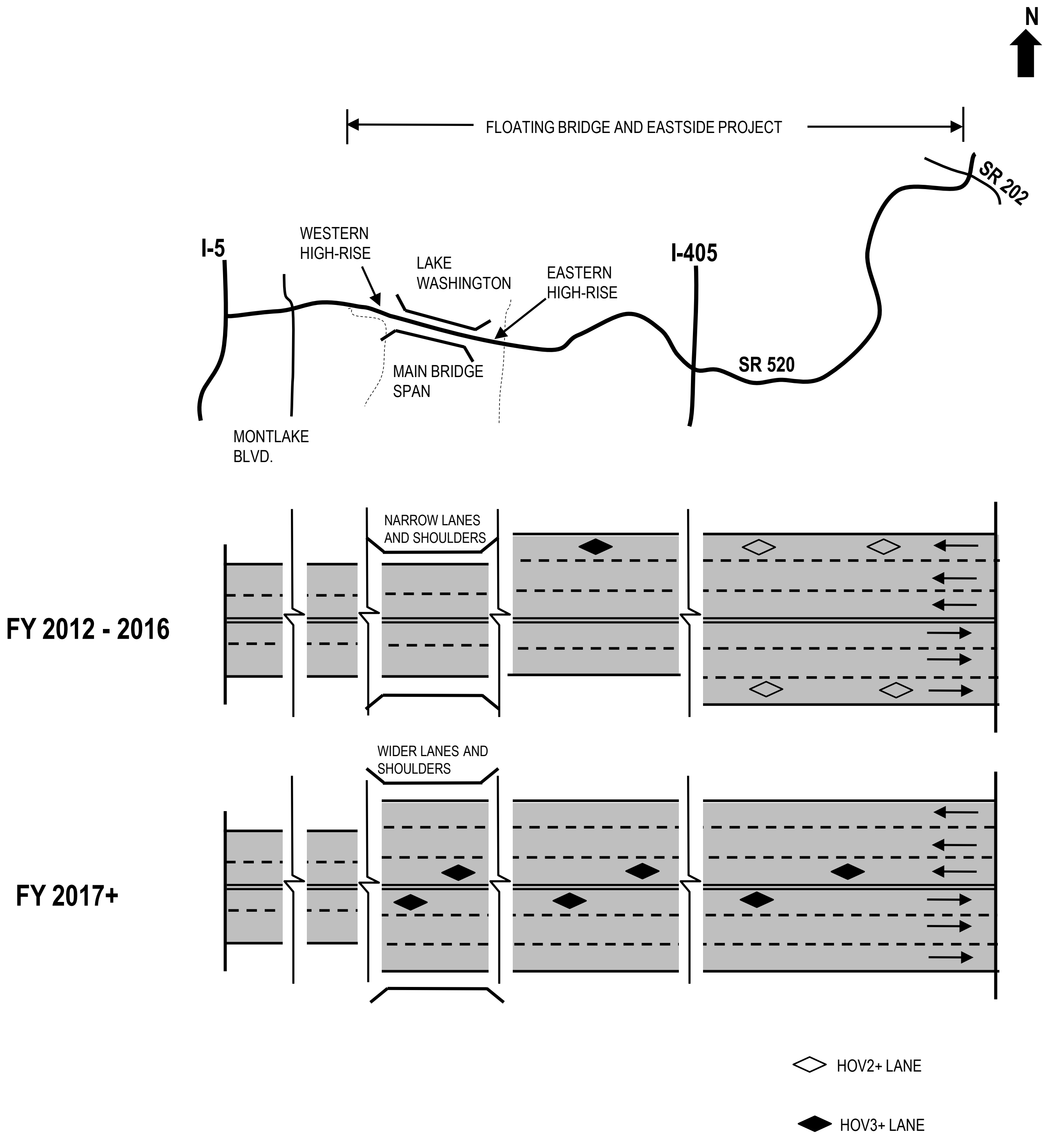
ASSUMED TOLLING PERIODS

Tolling on the existing SR 520 bridge is to begin January 1, 2012. Tolling will continue on the replacement bridge when it opens to traffic. From Fiscal Year (FY) 2012 through completion of the new bridge span, tolls will be collected on the SR 520 bridge in both directions at a single point on the eastern high-rise bridge. When the new span is complete and open to traffic, tolls will be collected in both directions at a single point on the eastern shore.

The SR 520 lane configurations assumed for this study are shown in Figure 1-2 and are explained below:

- From FY 2012 through FY 2016, it is assumed SR 520 will be configured as it is today:
    - From I-5 to the curve west of the western high-rise bridge: two general-purpose traffic lanes in each direction with existing entrance and exit ramps
    - From the curve west of the western high-rise to the eastern shore of Lake Washington (including the floating bridge main span): two general-purpose traffic lanes in each direction
    - East of Lake Washington to I-405: two general-purpose traffic lanes in each direction and one outside transit/ HOV lane (with 3+ occupancy requirement) in the westbound direction only
    - I-405 to SR 202 in Redmond: two general-purpose traffic lanes in each direction and one outside transit/HOV lane (with 2+ occupancy requirement) in each direction

- From FY 2017 through FY 2056, it is assumed SR 520 will be configured as :
    - From I-5 to the curve west of the western high-rise bridge: no changes – two general-purpose traffic lanes in each direction with existing entrance and exit ramps
    - From the curve west of the western high-rise to the eastern shore of Lake Washington (including the floating bridge main



ASSUMED SR 520 LANE CONFIGURATION BY YEARS

FIGURE 1-2

span): two general-purpose traffic lanes in each direction and one transit/HOV lane (with 3+ occupancy requirement) in each direction; lanes and shoulders on the new span will be wider than the current bridge
- East of Lake Washington to I-405: two general-purpose traffic lanes in each direction and one inside transit/HOV lane (with 3+ occupancy requirement) in both directions
- I-405 to SR 202 in Redmond: two general-purpose traffic lanes in each direction and one inside transit/HOV lane (with 3+ occupancy requirement) in each direction

The resulting replacement bridge is expected to increase capacity across Lake Washington. As noted in Figure 1-2, the current SR 520 bridge has narrower than standard lanes and shoulders. These will be increased to regular standard width on the new bridge. The wider general-purpose lanes will add capacity to the bridge. Also, incidents of vehicles blocking bridge lanes due to crashes or breakdowns will drop significantly since standard shoulders will be available for such vehicles. Finally, the addition of the transit/HOV lanes will allow multi-passenger and other qualified vehicles to leave the general-purpose traffic lanes and open up new capacity in the general-purpose lanes.

Lake Washington Urban Partnership Agreement

In 2007, Federal Highway Administration, WSDOT, the Puget Sound Regional Council (PSRC) (the Metropolitan Planning Organization for the region), and King County signed an Urban Partnership Agreement (UPA). This agreement includes key components:

- Implementation of variable pricing on SR 520 between I-5 and I-405 with the objective of maintaining free flow traffic
- Use of advanced technologies such as “Active Traffic Management” along SR 520 and I-90 to manage traffic operations
- Increased transit capacity on SR 520 through more extensive express bus service and related amenities
- Real-time multi-modal travel information
- Increased trip reduction measures

The UPA agreement provides federal funding to implement these components, which will often be combined with State and local funding, except for the trip reduction component, which will be completely State and locally funded.

TOLLING STUDIES AND AUTHORITY

This study, initiated in September 2009, is the first traffic and revenue study conducted for the SR 520 project by WSA. Previously-conducted preliminary tolling studies include internal studies by WSDOT, the legislatively mandated Tolling Implementation Committee completed in 2008, and ongoing financial analyses of the overall SR 520 project. In August 2009, the Washington Legislature authorized tolling on the SR 520 bridge. The Washington State Transportation Commission (WSTC) acts as the tolling authority and is tasked with decisions regarding setting toll rates. During the 2011 legislative session, both houses of the legislature passed legislation confirming the commission's responsibility for rate-setting published in Section 2, Chapter 377, Laws of 2011. The Office of the State Treasurer, working closely with WSDOT in arranging financing for SR 520, has also provided input on tolling scenarios to WSDOT and WSTC.

SR 520 OVERALL CONTEXT AS A TOLL FACILITY

A significant portion of the funding for reconstruction of the SR 520 bridge will come from the re-establishment of tolls in both travel directions. As noted previously, the SR 520 bridge had previously been a toll facility, but has operated toll-free since 1979.

While it will be a new toll project, the SR 520 bridge has a long history of stable traffic demand, averaging close to 100,000 vehicles per day over the last 18 years. As discussed in Chapter 2, the bridge has operated at or near capacity for many years, which has contributed to modest traffic growth over the last decade. While it is anticipated that there will be decreases in traffic as a result of the imposition of tolling, the SR 520 bridge will likely have considerably less risk from a revenue view point, than a purely "green field" toll facility project, constructed from scratch without an established usage pattern.

As noted above, this study assumes no improvements to SR 520 from I-5 to the curve before the western high-rise once construction is complete. This indicates that the current westbound chokepoint just before the main bridge span may be replaced by a similar chokepoint just west of the western high-rise. However, the effect of tolls on SR 520 traffic is anticipated to lower SR 520 traffic levels sufficiently to allow free flow operation (defined as 45 mph or better 90 percent of the time) through this transitional section.

The re-imposition of tolls on SR 520 will mark the second time a major bridge crossing in the Puget Sound region had tolls "re-established" to support major bridge improvements. Tolls were recently re-established on the Tacoma Narrows Bridge, after that facility operated as a toll-free crossing for many years. As anticipated, there was a slight reduction in traffic when tolls were introduced on the Tacoma Narrows Bridge, but the impact was limited. This was due to the fact that there are no practical alternatives to the Tacoma Narrows Bridge and traffic diversions to alternative routes are minimal. A trip from Tacoma to just south of Bremerton which takes about 24 minutes via the Tacoma Narrows Bridge compared to a trip time of one hour 50 minutes via Olympia or two hours plus ferry wait time via ferry.

The SR 520 crossing has alternative competitive routes, including the adjacent I-90 bridge across Lake Washington, about three miles to the south. Depending on the exact origin and destination, a trip currently using SR 520 could utilize an alternate route which takes no additional time. Even in the case where a current SR 520 trip might go eleven miles out of the way in the very extreme situation that both origin and destination are close to the SR 520 landings, at peak hour speeds this would likely take no more than an additional twenty minutes.

As will be described in more detail throughout this report, it is anticipated that the imposition of tolling on the SR 520 bridge will have a more significant negative impact on traffic, at least in the early years, than was experienced on the Tacoma Narrows Bridge. Traffic and revenue estimates in this report reflect estimated higher potential diversions to alternative facilities. Nonetheless, in comparison to a start-up "green field" project, the SR 520 bridge will benefit greatly from a well-established pattern of usage and because it is such a vital link in the Puget Sound transportation network. Based on travel pattern surveys conducted for this study, most trips now use SR 520 for commuting to/from work or conducting work-related activities. These types of trips would not be prone to significant reductions or redistributions within the region, at least in the short term. This is a further factor reducing the overall revenue risk on the tolled facility.

WSA SCOPE OF WORK

As the findings of this study are to be used for project financing, the study was conducted at a level of detail sufficient to support an investment grade study. WSA was retained to perform all the necessary tasks leading to the development of this report. These tasks included the collection of necessary data for the calibration of the regional travel demand model that would serve as the primary analytical tool. Existing data, including WSDOT annual traffic reports, were also reviewed. Inventories of the operating conditions including traffic counts and travel time/speed studies on competing and complementary routes within the study area were also conducted. The following discussion summarizes the primary tasks undertaken in this study. These tasks are explained in detail in subsequent chapters of this report.

TRAVEL PATTERNS SURVEY

WSA conducted a travel pattern survey in fall 2009. Mail-back surveys were sent to SR 520 bridge users whose addresses were collected from license plates of vehicles using the bridge. The survey requested information on a recent trip involving the SR 520 bridge. The survey requested information on origin and destination of travel, trip frequency, travel time of day, trip purpose, vehicle occupancy, vehicle class, and SR 520 entrance and exit point. The data collected in this task was used to refine the travel demand model to reflect bridge user origins, destinations, and characteristics; assist in estimating market shares by payment type based on trip frequency and purpose; and provide guidance in assessing the reasonableness of traffic and revenue estimates.

TRAVEL TIME SURVEY

WSA performed travel time surveys along SR 520 and on important routes that could be potential alternatives to SR 520 for major movements. In addition to WSA travel time surveys, WSDOT also provided travel time information based on roadway sensor data from 2008.

The data collected was used to calibrate the travel forecasting model prior to using it for tolling analysis.

STATED PREFERENCE SURVEY

A stated preference survey was initiated in fall 2009. The survey used an online survey instrument to ascertain current bridge users' reactions to tolling the SR 520 bridge. Possible changes in travel behavior included using alternate routes, changing destinations, combining trips or "trip chaining," not making a particular trip, changing travel time, and/or changing travel mode. The stated preference survey was completed by a sub-set of travel pattern survey respondents. The results were used to develop a statistical travel choice model which was used to forecast future travel behavior characteristics under tolled conditions including values of time, trip suppression, and mode shift.

TOLLING ANALYSIS MODEL DEVELOPMENT

The model development process involved compiling the PSRC regional model datasets and documentation, observed traffic data, and conversion of PSRC model data files to the WSA format. The converted files were checked for consistency against the source data, and then used to develop an initial highway traffic assignment model. Model runs under toll-free conditions were conducted. The results were compared against available traffic counts, travel time data, and the original PSRC model runs to ensure that the initial model results were generally consistent with the observed conditions and prior efforts. The model was then calibrated in the immediate project area to ensure traffic assigned to the roadway network compared closely to observed traffic counts and speeds. Once a calibrated traffic assignment model was developed, the next step in the development of a tolling analysis model incorporated the WSA tolling analysis algorithm within the assignment model. WSA also incorporated results of the travel pattern survey, stated preference survey, independent corridor growth review, and travel time surveys to enhance the original model inputs with observed information. Finally, additional calibration checks were performed using screen-line volumes and travel time comparisons along several key corridors prior to using the model for the analysis of toll scenarios.

Independent Corridor Growth Analysis

Socioeconomic activity is the basis of all travel demand models. Regional planning agencies such as PSRC spend a large amount of their resources studying area-wide growth and development. Since local and regional economic performance provides a crucial indicator of future travel demand, an independent economic review was conducted to update the PSRC data. This review utilized independent regional forecasts which account for the recession and overall economic downturn, data on economic and real-estate activity, and review of area development plans as the basis for revised population and employment forecasts for the region. These results were then incorporated into the Tolling Analysis Model by changing overall trip demand in the geographic areas which heavily influence travel demand on SR 520 and the cross Lake Washington corridor.

Traffic and Revenue Analysis

WSA utilized the Tolling Analysis Model to analyze several preliminary toll structures as requested by WSDOT. Toll structures tested included those from prior studies and variations such as different initial toll rates, lower and higher annual changes in toll rates, toll rate changes upon bridge completion, and revenue optimizing toll rates. Preliminary toll structures were tested from February 2010 through fall 2010. Through a detailed review and refinement of these preliminary tolling structures, WSTC adopted a FY 2012 tolling structure for SR 520 on January 5, 2011, pending Legislative action noted above.

The adopted FY 2012 tolling structure contains four primary weekday toll rates. Initial (FY 2012) Account-based passenger car toll rates will range from $1.60 during off-peak to $3.50 during peak times in each direction on weekdays. Each peak period is bracketed by one hour shoulders with lower rates. Midday and evening tolls are lower than the shoulders, and early morning and late evening off-peak tolls are the lowest of the four toll levels. Adopted FY 2012 weekend base tolls vary from $1.10 to $2.20. Adopted weekend rates are broken into three primary rates: a single long midday peak period from 11 am to 6 pm that reflects weekend travel demand, a set of three hour shoulders around this midday period at lower tolls, and early morning and late evening periods at the lowest tolls. Adopted FY 2012 rates for multi-axle vehicles are based on the per-axle rate of the base two-axle vehicle toll. Due to the costs associated with different types of toll payment, users who do not use an Account-based transaction will pay an additional $1.50 per transaction.

During the tolling structure discussions, WSTC also reviewed a financing plan which assumed 2.5 percent average toll rate increases at the beginning of each fiscal year from FY 2013 through FY 2016, a 15 percent weekday and 2.5 percent weekend average increase beginning FY 2017, and no toll increases from FY 2018 onward. This results in toll rates decreasing in real dollar terms after 2017. The finance plan also assumes that during bridge construction tolls will not be collected between 11 pm and 5 am, assumed to be through FY 2016. Beginning in FY 2017, tolls are assumed to be collected 24 hours a day.

The final investment grade traffic and revenue scenario was based on the FY 2012 adopted tolling structure and the tolling structure in the financing plan reviewed by WSTC.

The major steps in the traffic and revenue forecasting process include:

- Translating the proposed toll structure into the Tolling Analysis Model
- Running the model to evaluate traffic and revenue impacts for key analysis years (FY 2012, FY 2016, FY 2017, FY 2024, and FY 2031)
- Using the model results to develop the expanded traffic and revenue forecast from FY 2012 to FY 2056

Specific information on the tolling structure, associated toll and fee levels, and project details are given later in this report.

Sensitivity Tests

In order to ascertain the impact of possible changes in input parameters and their effect on traffic and revenue, several sensitivity tests were performed, involving variations in the following parameters and assumptions:

- Regional growth
- Value of time
- Account-based participation rate
- Motor fuel cost
- Trip suppression and mode shift
- Possible tolling of the I-90 bridge

Each of these parameters and assumptions was tested for a range of variability to determine the possible impacts on expected revenue.

REPORT STRUCTURE

The remainder of this report is presented in the following order:

- Chapter 2 covers existing roadway physical and operational conditions and data collection. It also summarizes the results of the travel pattern and travel time surveys.

- Chapter 3 includes a summary of the stated preference survey objectives, survey instrument, and basic results. It also summarizes model estimation, value of time, trip suppression, mode shift, and time shift.

- Chapter 4 addresses the independent assessment of economic growth forecasts within the bridge influence area. This includes a summary of the information used to help with the economic forecast and determine the impacts of the recession on short and long-term socioeconomic forecasts.

- Chapter 5 discusses the tolling system assumptions used in this study. This section includes methods of payment, vehicle classes, and vehicles exempt from tolls. It also contains the assumed market shares for each payment type and a summary of the marketing activities for the tolling program.

- Chapter 6 discusses the traffic and revenue analytical process. The methodology is outlined along with its application to the overall traffic and revenue estimation process. This chapter includes details about conversion of the PSRC regional model and development of the WSA Tolling Analysis Model as well as basic assumptions including future roadway and transit improvements, and toll rate details.

- Chapter 7 includes the results of traffic and revenue analysis in the form of an estimated 45-year traffic and gross revenue stream.

- Chapter 8 contains the results of sensitivity testing of key model parameters and assumptions.

CHAPTER 2

EXISTING TRAFFIC CONDITIONS

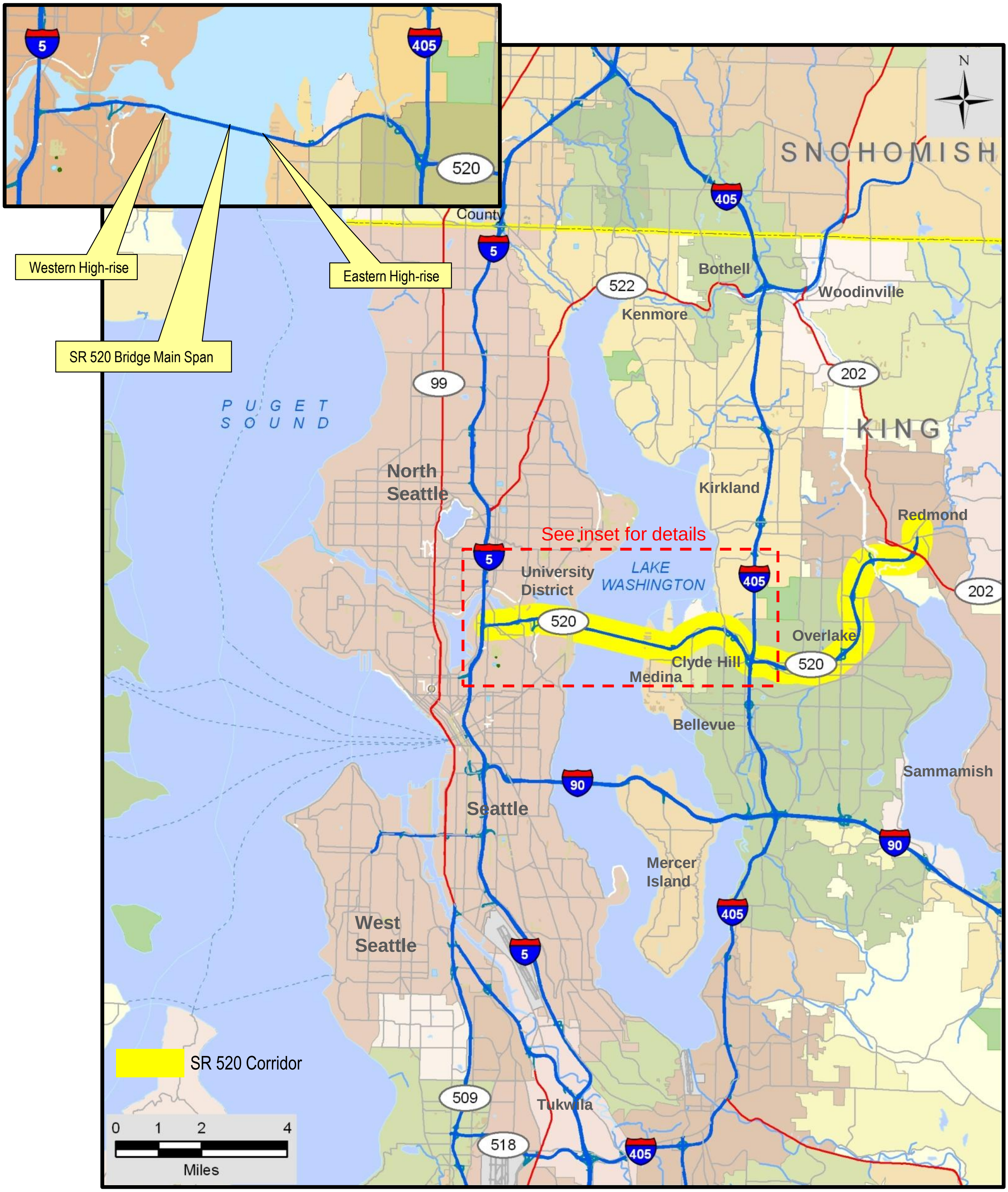
A key element of any traffic study is understanding existing traffic operations and travel behavior. This is achieved through extensive data collection and a review of data collected and maintained by Washington State Department of Transportation (WSDOT). As the State Route 520 (SR 520) corridor is a well-established route, the data available includes extensive historical traffic count information. This chapter summarizes the information that was either extracted through a review of available reports/documents or collected by Wilbur Smith Associates (WSA) as part of our work.

The information provided in this chapter includes a description of the highway system in the Seattle area, existing traffic volumes, traffic variations, and travel time and speed along major corridors related to the SR 520 project. The existing highway system is described in terms of major highways, their number of lanes, and posted speed limits. Traffic demand is described in terms of daily traffic on major corridors, and Annual Average Daily Traffic (AADT) based on the Permanent Traffic Recorder (PTR) stations located throughout the region. Based on the PTR data, traffic variation by seasons, days, and hours was reviewed and summarized. Information on travel time and observed speed along major routes in the vicinity of the project is based on surveys conducted by WSA. Wherever appropriate, tabular information is augmented by corresponding maps and graphics to facilitate understanding.

EXISTING HIGHWAY SYSTEM

MAJOR ROUTES

The major roadways in the study area are shown in Figure 2-1. SR 520 and I-90 serve as the major roadways across Lake Washington. SR 520 provides direct connections for eastern suburb residents and businesses in Bellevue, Kirkland, and Redmond to reach the University District and I-5 with connections to downtown Seattle. It also allows residents and businesses in Seattle access to major employment centers in downtown Belle-



SR 520 CORRIDOR LOCATION

FIGURE 2-1

vue and to Microsoft, located in the Overlake area of Redmond. I-90 provides an alternative to SR 520 between I-5 and I-405; it is the only roadway connection for residents and businesses of Mercer Island to the mainland, and it serves additional eastern suburbs such as Issaquah. Most importantly, I-90 serves as the major east-west connection for the greater Seattle area to the rest of the U.S. Consequently it has much higher truck travel than SR 520 and also suffers from traffic congestion.

I-5 and I-405 form the major north-south corridors on the west and east side of Lake Washington, respectively. I-5 is the major north-south access from Seattle to the northern and southern suburbs as well as the rest of the U.S. and British Columbia, Canada. It serves many commuter, long distance passenger, business, and freight trips. I-405, in addition to providing access to communities and businesses east of Lake Washington, serves as an alternative to I-5 for long distance travel. The combination of I-5 and I-405 can be used as an alternative to the Lake Washington bridges when traveling east-west by going north or south of the lake. However, by avoiding Lake Washington, travel time and distance increase.

SR 522 extends from I-5, north of downtown Seattle, east to I-405 at Bothell and beyond. It has interchanges at I-5 and I-405. It is a four lane signalized arterial with turning lanes. SR 522 acts as a major local residential connector as well as a commercial corridor for North Seattle, Kenmore, and Bothell. When combined with I-405 north of Bellevue, it can be part of an alternative to the Lake Washington bridges. The distance is shorter than the I-5/I-405 combination north of the lake; however, signals, slower speed limits, and local traffic make SR 522 a time-intensive alternative.

Description of Major Routes

Further information about major routes in the project area is provided below:

SR 520 is the northern of the two east-west routes across Lake Washington. The route starts in the west at I-5 and continues east for 12.8 miles to NE Union Hill Road/SR 202. The route has two general-purpose lanes in each direction along its length. It currently has High Occupancy Vehicle (HOV) lanes east of Lake Washington. Between Lake Washington and the I-405 interchange, SR 520 has one outside westbound HOV lane with a 3+ occupancy requirement (HOV 3+). East of the I-405 interchange it contains one outside HOV lane in each direction both with a 2+ occupancy requirement (HOV 2+). SR 520 is busiest from the Montlake interchange on the west end of the bridge, across Lake Washington, and to the Overlake area near the 148th Avenue NE interchange. AADT in this area is approximately 100,000. The portion of SR 520 of interest in this study is the segment from I-5 to I-405 which includes the floating bridge.

I-90 is the southern of the two east-west routes across Lake Washington. It is a 3,100-mile trans-continental route, which starts on the west end at I-5, and ends at Boston's Logan International Airport on the east end. The portion of I-90 of interest in this study is the segment from I-5 to I-405. Between I-5 and I-405, I-90 generally contains three general-purpose lanes in each direction, plus two reversible HOV-only express lanes (which are barrier-separated). From Mercer Island to Bellevue Way, there are two additional westbound HOV lanes on the outer roadway and one additional eastbound HOV lane on the outer roadway. East of I-405, I-90 contains one HOV and three general-purpose lanes in each direction. All I-90 HOV lanes are HOV 2+. Travel on the I-90 Bridge west of Mercer Island has an AADT of about 126,000 vehicles.

I-5 extends 1,400 miles from the U.S.-Mexico border on the south to the U.S.-Canada border on the north. It is the primary north-south route, both within the Seattle metropolitan area and along the west coast of the U.S. South of I-90, I-5 maintains four general-purpose lanes and one HOV lane in each direction. All I-5 HOV lanes require 2+ occupancy per vehicle. North of I-90, the route enters downtown Seattle and undergoes numerous lane configuration changes. There are three notable lane configuration elements:

- There is a collector-distributor road in each direction between I-90 and Seneca Street (where the three-block long I-5 Tunnel starts).
- Reversible lanes start on the south at James Street with the northbound entrance/southbound exit between the two main travel directions resulting in left side entrance/left side exit ramps respectively.
- Northbound mainline I-5 reduces to two lanes for a short segment north of the drop-lane exit to Seneca Street and south of the add-lane entrance from the collector-distributor road.

North of downtown, I-5 generally contains four general-purpose lanes in each direction, plus a set of four reversible express lanes. The number of lanes begins to reduce north of SR 522 (Lake City Way), where the Express Lanes and both directions of the general-purpose lanes reduce to three lanes each. North of NE 92nd Street, the express lanes end, but the outer roadway lanes increase to four general-purpose and one HOV northbound and three general-purpose and one HOV southbound. North of NE 175th Street, I-5 reduces to four lanes in each direction (three general-purpose, one HOV).

The portion of I-5 of interest in this study is from I-405 in the south to I-405 in the north, and particularly the section between I-90 and SR 520 as it provides access to both cross-lake bridges from downtown Seattle. Travel on I-5 can be heavily congested and has an AADT ranging from 186,000 south of I-90 to 259,000 just north of downtown Seattle.

I-405 is 30.3 miles in length, and terminates at I-5 on both the north and south. The southern terminus in Tukwila is near SeaTac Airport. West of I-5 at this southern terminus, the roadway continues west at SR 518 to provide direct limited access connections with SeaTac Airport and SR 509. On the north, I-405 terminates in Snohomish County in the suburb of Lynnwood. I-405 was originally constructed as a bypass route around Seattle; however, it has become an important corridor in its own right, serving the suburbs of Renton, Bellevue, Redmond, and Kirkland among others. Much of I-405 is heavily congested during peak periods. The busiest section is in Bellevue at the SE 8th Street interchange, which has an AADT exceeding 180,000 vehicles. I-405 has between three and five lanes in each direction. It is generally three lanes (two general-purpose/one HOV) in each direction south of I-90 and north of SR 522. Between these interchanges, it is generally four lanes in each direction (three general-purpose/one HOV). The entire length of I-405 is of interest to this study; the section between SR 520 and I-90 is particularly important as it provides access to both cross-lake bridges from downtown Bellevue.

SR 522 is the shortest route around the north end of Lake Washington. In the west the route starts at I-5 at the Lake City Way interchange (near NE 73rd Street). It has an interchange with I-405 near NE 180th Street. SR 522 then continues east of I-405 as a limited access route, and terminates at U.S. Highway 2 in the city of Monroe. The section between I-5 and I-405, which provides an alternative to the SR 520 bridge, is 11.0 miles long and of interest in this study. This section is not access controlled, and contains a total of 29 signalized intersections. The speed limit ranges from 30 to 45 miles per hour in this section. The I-5 to I-405 section contains two general-purpose lanes in each direction for the entire length. Portions of the route contain Business-Access & Transit (BAT) Lanes, as well as a Two-Way Left-Turn Lane (TWLTL) segments. There are no permanent traffic counting stations on SR 522 in this section to determine AADT. However, data from weekday short duration counts (usually two to four days) on the roadway indicate daily volumes of 25,000 to 51,000 vehicles depending on location.

A summary of key attributes of the above routes is provided in Table 2-1.

Table 2-1
Summary of Lane Configurations on Major Routes

Route	Location	Length * (miles)	Direction	Lanes **	Access Type	Posted Speed (mph)
I-5	Tukwila to Lynnwood, West of Lake Washington	28	North-South	2-5, plus 3-4 reversible	Controlled	60
I-405	Tukwila to Lynnwood, East of Lake Washington	30	North-South	3-5	Controlled	60
I-90	I-5 to east of I-405	8	East-West	3-4 plus 2 reversible	Controlled	40/60
SR 520	I-5 to Avondale Road (SR 202)	14	East-West	2-3	Controlled	40/50/60
SR 522	I-5 to I-405	11	East-West	2	Signals	30/35/45

* = Approximate Length in study area ** = Lanes per direction

SPECIAL LANE CONFIGURATIONS

There are numerous lane configuration changes throughout the study area and very complex lane configurations in some areas, particularly the I-5 corridor in downtown Seattle. In addition to general-purpose lanes which are open to all vehicle types, there are several types of special purpose lanes used in the Seattle area, as listed in Table 2-2.

Table 2-2
Special Purpose Lanes on Major Routes

Special Lane Types	Routes Where Provided
High Occupancy Vehicle (HOV) Lanes	I-5, I-405, I-90 and SR 520
Collector-Distributor (C-D) Roads	I-5, I-405, I-90 and SR 520
Reversible Express Lanes	I-5 and I-90 only
Business Access & Transit (BAT) Lanes	SR 522 only
Two-Way Left-Turn Lanes (TWLTL)	SR 522 only

SPEED LIMITS

The speed limits on all interstate routes within the study area are signed for 60 mph. The only exception is a short segment of I-90 between its western terminus and I-5, which is signed for 40 mph. The speed limit on SR 520 is generally 50 mph between I-5 and the eastern side of Lake Washington and 60 mph east of Lake Washington. The speed on SR 522 changes several times between I-5 and I-405, and varies between 30, 35, and 45 mph.

WSDOT recently put advanced traffic management systems in place. These consist of variable speed limit signs, lane control signs, and variable message signs. The new signs post variable speed limits that warn drivers of backups ahead and smooth out traffic as it approaches a lane block incident. The overhead signs can quickly close entire lanes and provide warning information to drivers before they reach slower traffic. The advance notification and variable speed limit signs help reduce collisions that cause backups and stop-and-go traffic. The new system makes the two bridges over Lake Washington safer and helps better manage and clear blocking incidents.

These systems have been installed on SR 520 for most of its length and on I-5 south of I-90, both of which have been fully operational for a number of months. A similar system has recently been installed on I-90 from I-405 to I-5 and was operational in June 2011.

TRAFFIC TRENDS & VARIATIONS

This section provides the following traffic volume data from the major highways in the SR 520 study area:

- Annual Average Daily Traffic (AADT) – average traffic per day over a complete year
- Average Weekday Traffic (AWDT) – average traffic per weekday (Monday-Friday) over a complete year
- Monthly variations
- Daily variation
- Vehicle classification counts
- Travel time and speed

DATA SOURCES

Traffic volume and travel pattern data presented in this section is based on the following sources:

- WSDOT Annual Traffic Reports: Historical count data was obtained from WSDOT Annual Traffic Report for various years. This data is compiled by the Statewide Travel and Collision Data Office (STCDO) at WSDOT's headquarters in Olympia. The STCDO maintains its own permanent count stations throughout the state, including several in the Seattle area. This traffic data is very comprehensive and much historical data is available. There are a limited number of count locations. In the WSDOT Northwest Region, the WSDOT Northwest Region Traffic Management Center maintains nearly 6,000 induction loop detectors throughout the Greater Seattle area. They provide comprehensive, continuous loop detector data (aggregated at 5-minute intervals) from which WSA extracted the 2008 data discussed herein. As the WSDOT detector locations are more numerous than the permanent STCDO stations, they provide a clearer picture of corridor traffic but extensive historical information was not available.

- Supplemental Counts: WSA performed supplemental traffic counts in 2009 to corroborate traffic volumes on mainline SR 520, as well as SR 520 entrance and exit ramps.
- Travel Time Surveys: WSA performed travel time and speed surveys on major routes in the Seattle area.

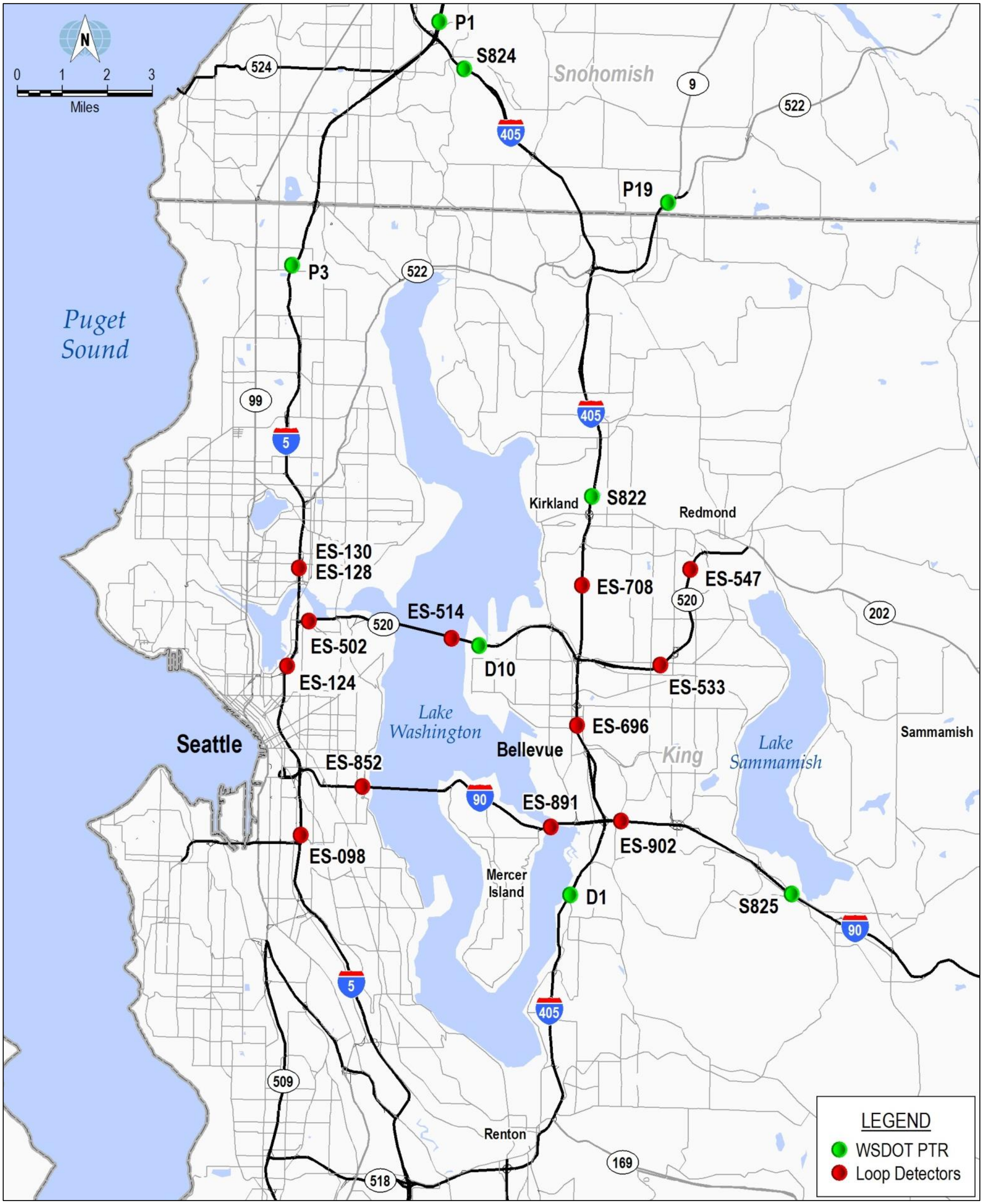
Annual Average Daily Traffic

Figure 2-2, 2-3, and 2-4 provide traffic data. Figure 2-2 shows the locations of WSDOT Permanent Traffic Recorders and loop detectors in the project vicinity. The data from these locations was reviewed and summarized in the form of a 2008 AADT map included as Figure 2-3. The historical growth trend was determined using data from the years 2002 and 2008. A map showing historical growth is shown in Figure 2-4.

Figure 2-4 shows that the change in traffic from 2002 to 2008 is relatively small at most PTR locations. On SR 520, there is a small decrease of 0.6 percent per year during this period. Further review of the trends was conducted for selected locations, as discussed below.

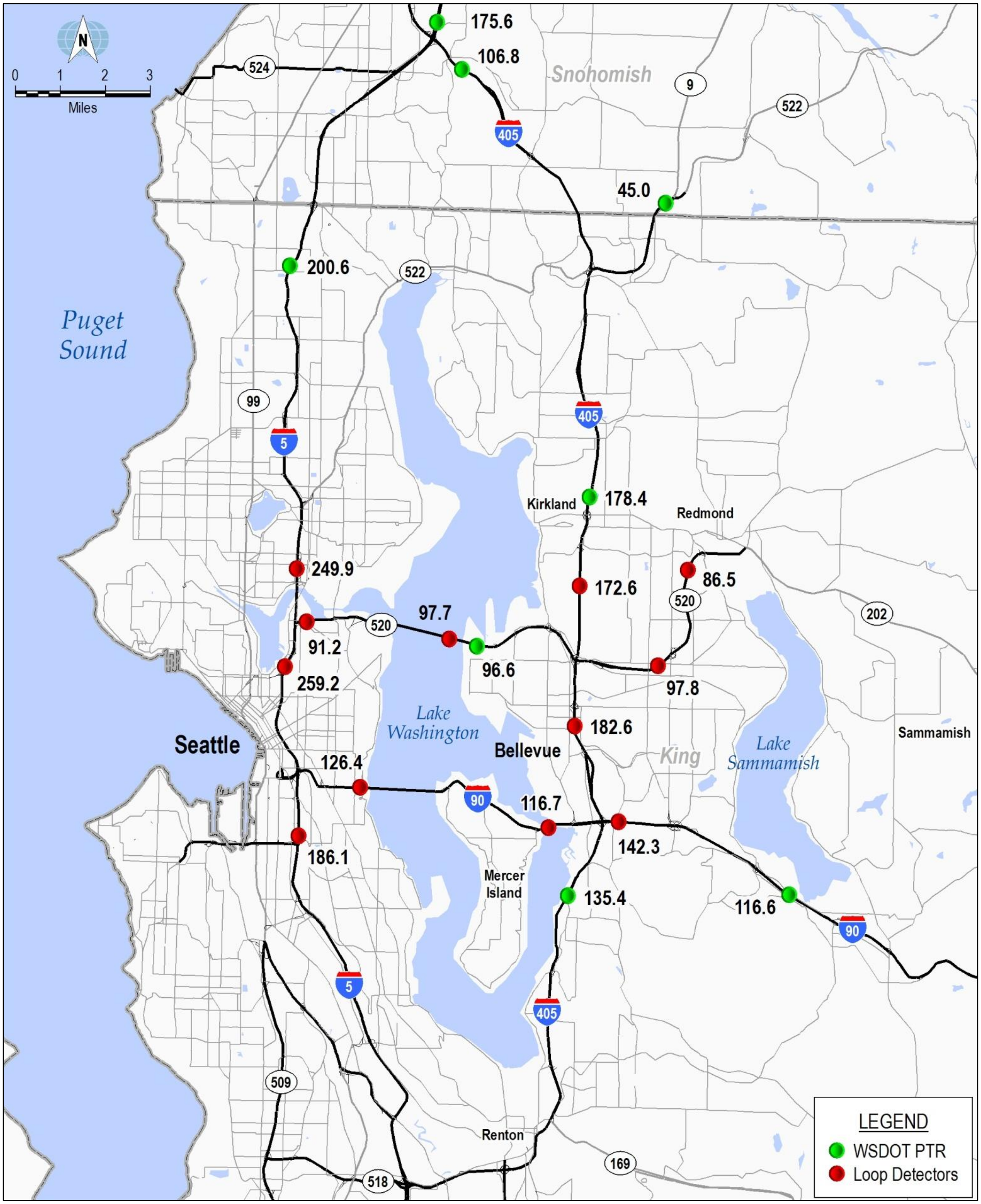
Historical Traffic Trends

Historical AADT from 1992 through 2009 was reviewed to determine longer-term historical trends. Figure 2-5 shows the data for east-west routes, namely SR 520, I-90, and SR 522. Note, the data for the I-90 station was used as it was the closest available; however, it is considerably east of the lake and may not truly be indicative of traffic patterns across the lake. The data indicates that each route has maintained steady traffic in recent years. On SR 520, there was some decrease in traffic from 2005 to 2008, but the 2009 AADT does not indicate the continuation of a downward trend. In general, traffic on SR 520 has been consistent for the past twenty years due to capacity constraints. Similar review of north-south routes, I-5 and I-405, was performed for 1992 through 2009; the data is shown in Figure 2-5. The general observation is similar to the east-west routes in that traffic has been steady and does not indicate a downward trend except for a decrease in 2008 and 2009. Traffic levels on routes in



WSDOT COUNT LOCATIONS IN THE VICINITY OF PROJECT AREA

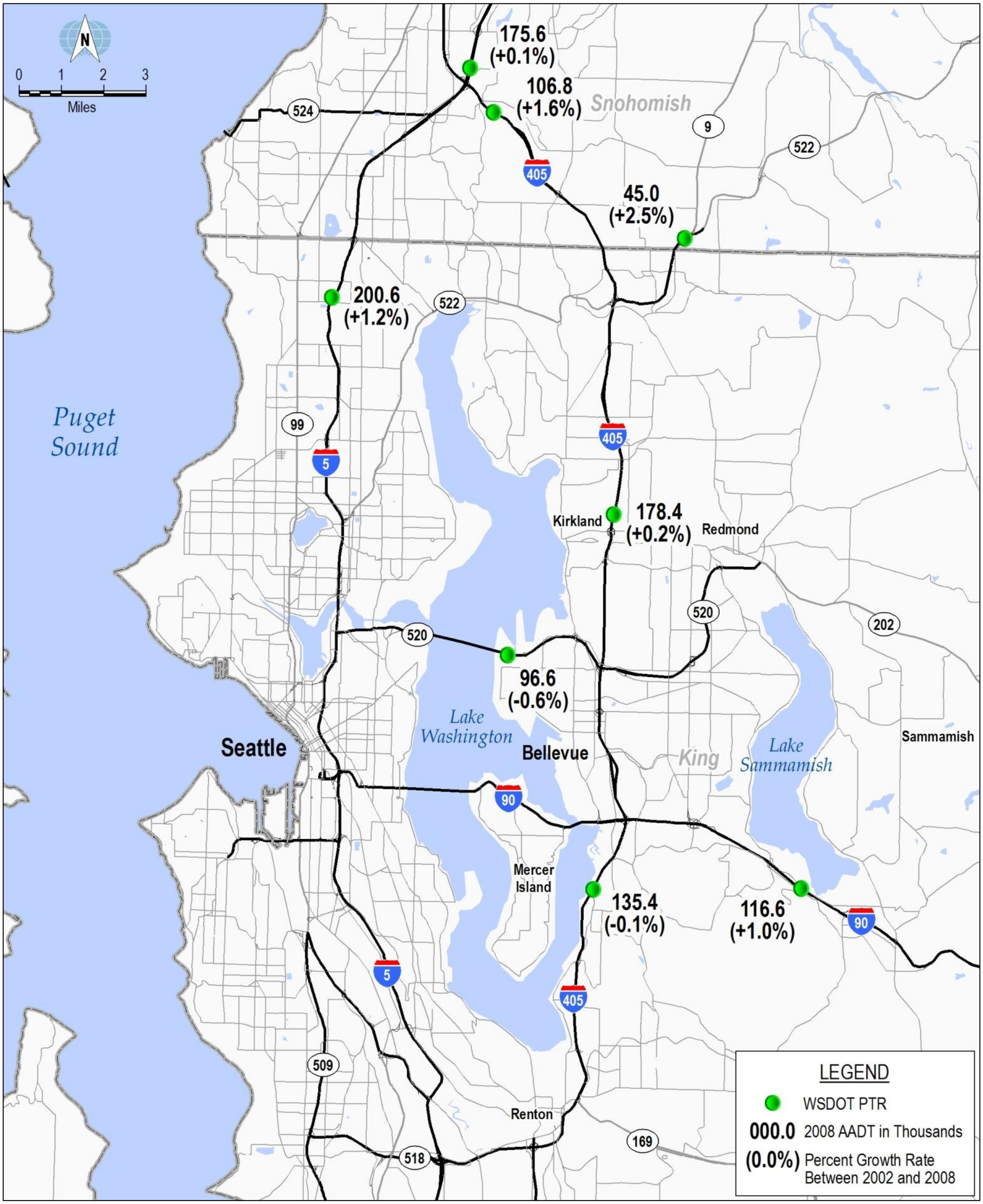
FIGURE 2-2



Data Source: WSDOT Annual Traffic Report 2008 and WSDOT NW Regions CDR for 2008.
Note: All AADT values are in 1,000's and represent total of both directions.

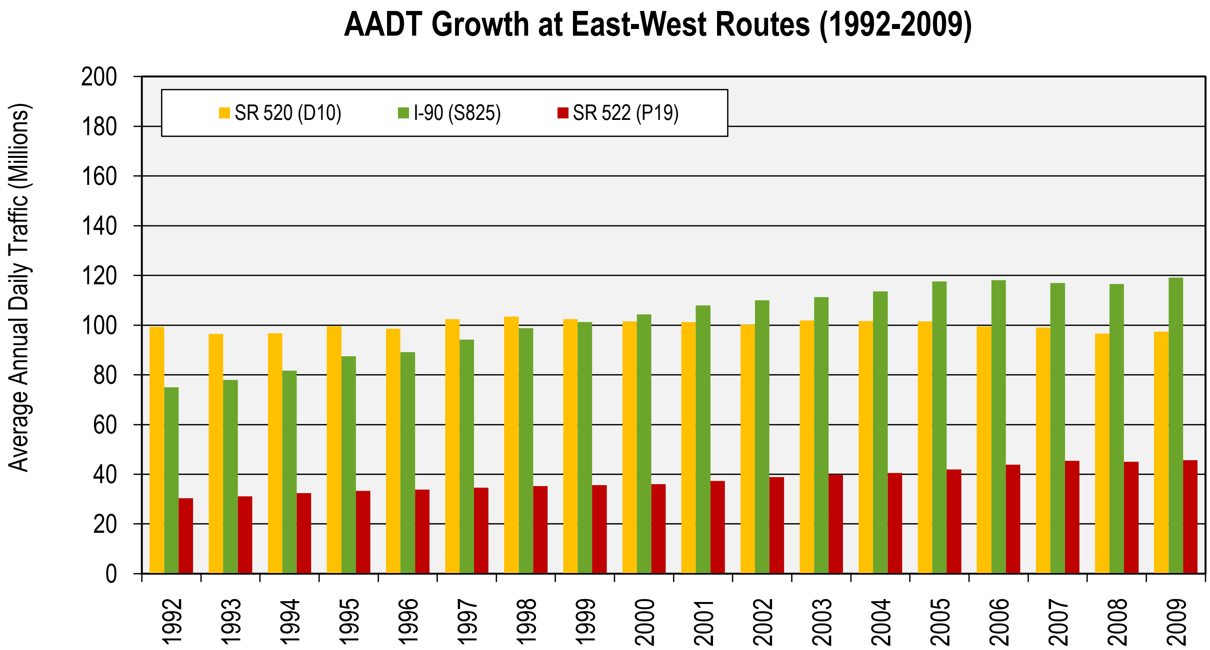
2008 ANNUAL AVERAGE DAILY TRAFFIC (AADT) ON MAJOR ROUTES IN THE PROJECT AREA

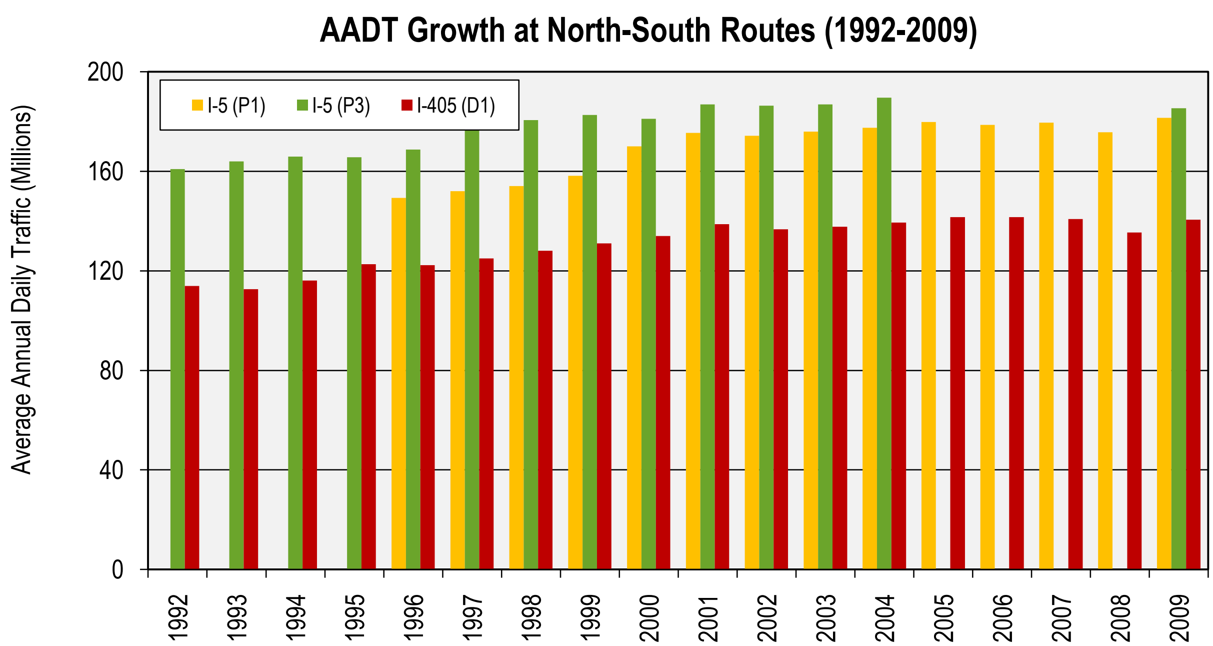
FIGURE 2-3



ANNUAL AVERAGE DAILY TRAFFIC (AADT) GROWTH AT PERMANENT TRAFFIC RECORDER (PTR) LOCATIONS (2002-2008)

FIGURE 2-4





Notes:
For data locations please refer Figure 2-2
Missing bars in graph indicate data was unavailable,
either because of lane construction or because of equipment problems

1992-2009 ANNUAL AVERAGE DAILY TRAFFIC (AADT) GROWTH

FIGURE 2-5

this corridor have been very stable since 1992 despite large gasoline price fluctuations and a major recession.

Highway traffic loop sensors are sensitive pieces of equipment and have to be properly installed, particularly the type of sensor WSDOT uses on I-5. Construction on I-5 required the contractor to remove and then reinstall the sensors. During construction no data was collected. After the sensors were reinstalled by the contractor, synchronization of dual-axle sensors was off, resulting in unusable data. As a result, charts in this report do not report AADT data for I-5 between 2005 and 2008.

AVERAGE WEEKDAY TRAFFIC

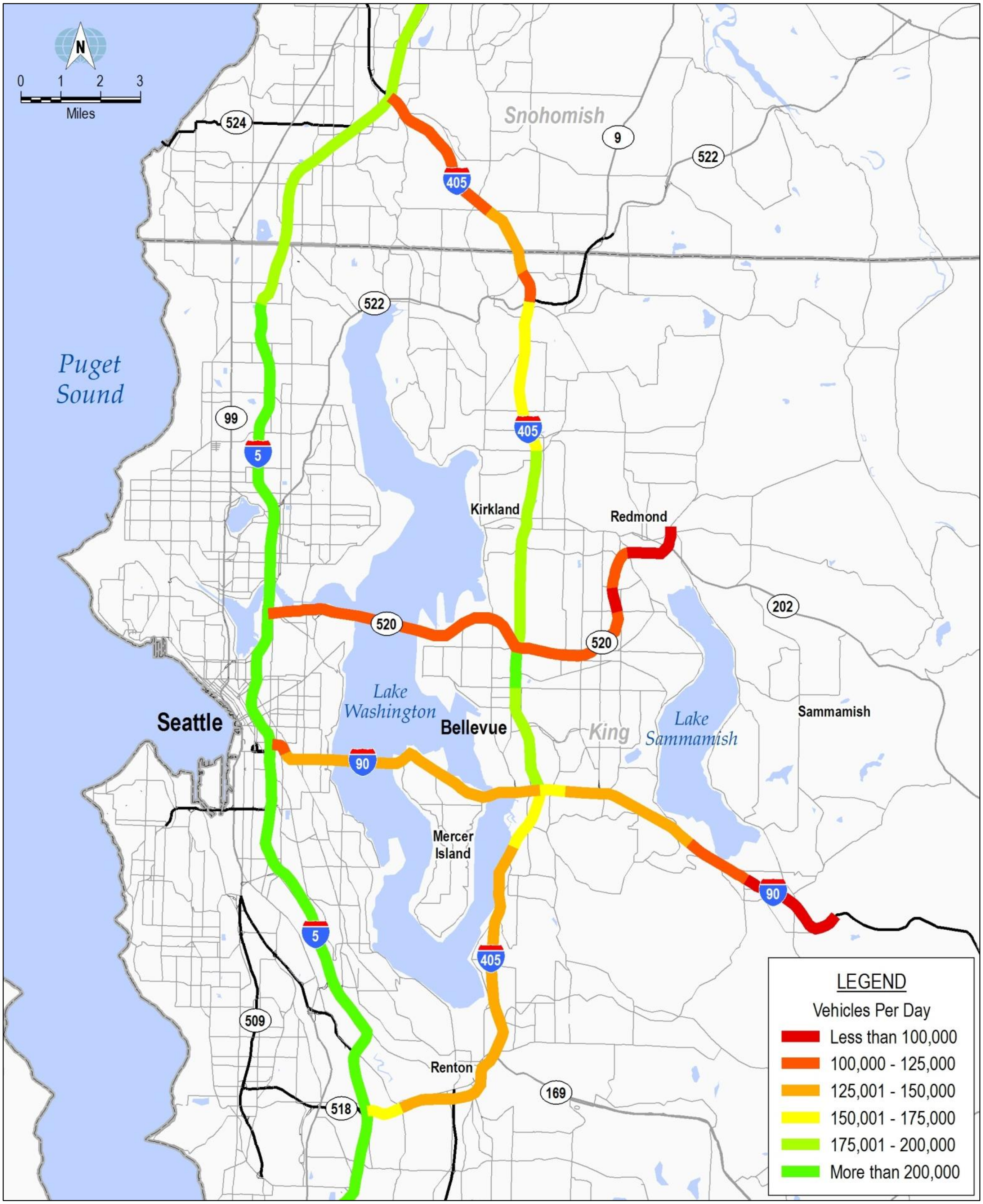
In addition to AADT, a review of the WSDOT 2008 Ramp and Roadway Report was performed to determine the weekday traffic levels on major facilities in the Seattle metro area. Using the AWDT data, a map was prepared as shown in Figure 2-6 which shows the 2008 AWDT volumes throughout the Seattle area.

The AWDT map shows that both north-south routes, I-5 and I-405, have high weekday volumes. I-5 approaches or exceeds 200,000 vehicles per weekday from I-405 on the north to well south of the I-405 on the south (near SeaTac Airport). I-405 also approaches or exceeds 200,000 vehicles per weekday between I-90 and NE 97th Street (in Kirkland).

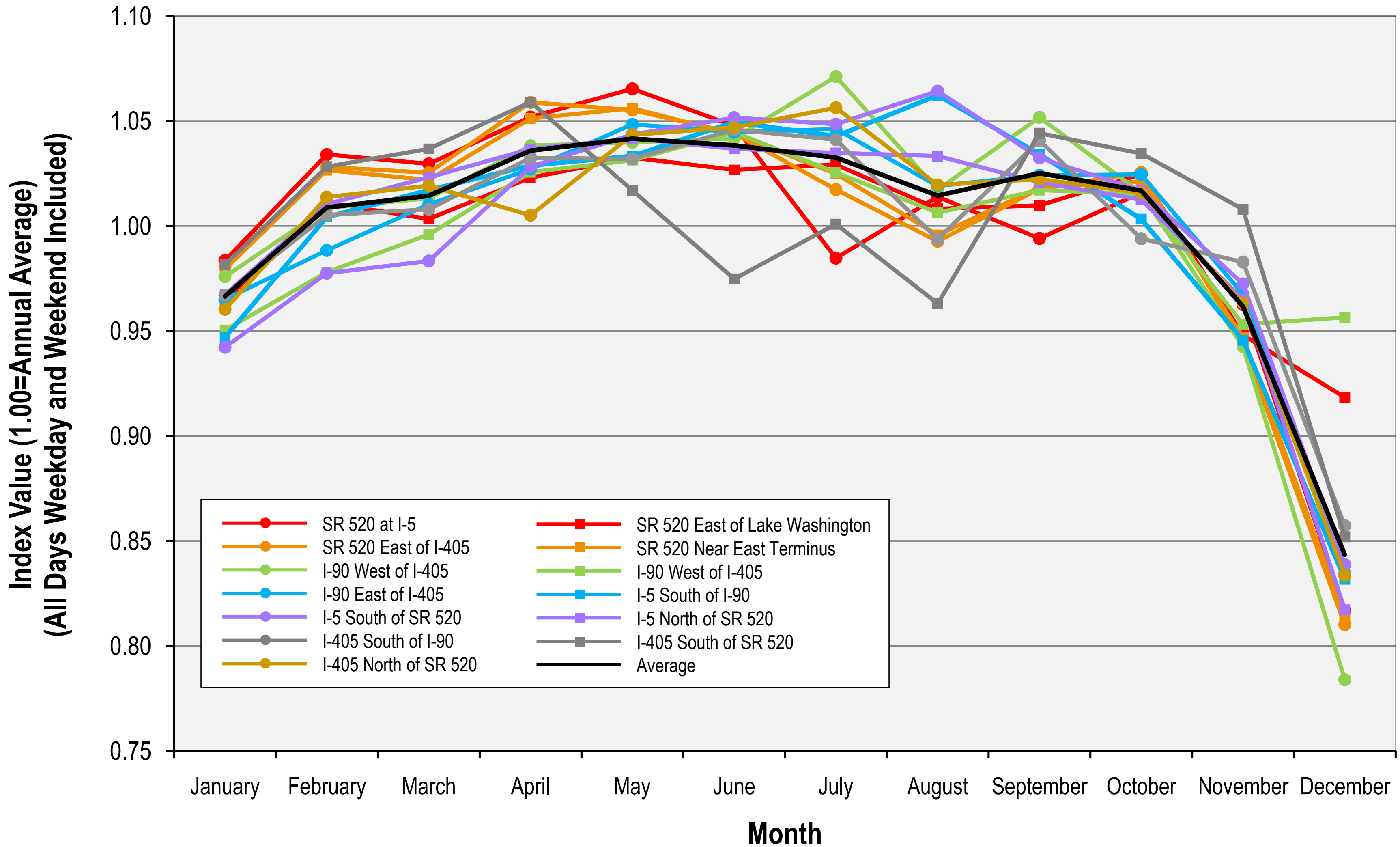
The two major east-west routes also have high volumes, but less than either of the north-south routes. SR 520 has just over 100,000 vehicles per weekday for most of its length (the exception being the segment between the NE 60th Street interchange and the east terminus). AWDT volumes on I-90 between I-5 and I-405 are approximately 140,000 vehicles. Weekday volumes on I-90 do not drop below 100,000 vehicles until east of Lake Sammamish, which is seven miles east of I-405.

TRAFFIC VARIATIONS

The data illustrating the monthly, day-of-week, and hourly variations for the loop detector locations was obtained from the 2008 NW Traffic Data CD and is shown in Figure 2-2. The locations capture all legs of the four major system interchanges in the Seattle metropolitan area (I-5 at I-90, I-5 at SR 520, I-405 at I-90, and I-405 at SR 520). Summary tabulations and graphs were prepared for seasonal variations, daily variations, and time-of-day variations at these locations.



2008 AVERAGE WEEKDAY DAILY TRAFFIC (AWDT) ON MAJOR ROUTES



Note: December 2008 was an atypical month due to severe winter storms

2008 MONTHLY ADT VARIATION ON MAJOR ROUTES

FIGURE 2-7

SEASONAL/MONTHLY VARIATIONS

Using the data CD application, WSA queried the monthly traffic volume variation at the locations noted above. To make monthly traffic volumes comparable among locations with different volume levels, the average daily volumes by month were converted to "index values" by dividing the average daily traffic volume for each month by the AADT volume at that location. Table 2-3 shows the index values for each location and month, while Figure 2-7 shows this data graphically.

Table 2-3
Monthly Variation Index at Selected Locations

Route	Location	January	February	March	April	May	June	July	August	September	October	November	December
SR 520	At I-5	0.98	1.03	1.03	1.05	1.07	1.05	0.98	1.01	0.99	1.02	0.96	0.82
SR 520	East of Lake Washington	0.96	1.01	1.00	1.02	1.03	1.03	1.03	1.01	1.01	1.02	0.95	0.92
SR 520	East of I-405	0.98	1.03	1.03	1.06	1.06	1.04	1.02	0.99	1.02	1.03	0.94	0.81
SR 520	Near East Terminus	0.98	1.03	1.02	1.05	1.06	1.04	1.02	1.00	1.02	1.02	0.95	0.81
I-90	West of I-405	0.98	1.01	1.01	1.04	1.04	1.04	1.07	1.02	1.05	1.02	0.94	0.78
I-90	West of I-405	0.95	0.98	1.00	1.03	1.03	1.04	1.03	1.01	1.02	1.02	0.95	0.96
I-90	East of I-405	0.97	0.99	1.01	1.03	1.05	1.04	1.05	1.02	1.02	1.02	0.97	0.83
I-5	South of I-90	0.95	1.00	1.02	1.03	1.03	1.05	1.04	1.06	1.03	1.00	0.95	0.83
I-5	South of SR 520	0.94	0.98	0.98	1.03	1.04	1.05	1.05	1.06	1.03	1.02	0.97	0.84
I-5	North of SR 520	0.97	1.01	1.02	1.04	1.04	1.04	1.03	1.03	1.02	1.01	0.97	0.82
I-405	South of I-90	0.97	1.01	1.01	1.03	1.03	1.05	1.04	0.99	1.04	0.99	0.98	0.86
I-405	South of SR 520	0.98	1.03	1.04	1.06	1.02	0.97	1.00	0.96	1.04	1.03	1.01	0.85
I-405	North of SR 520	0.96	1.01	1.02	1.01	1.04	1.05	1.06	1.02	1.02	1.02	0.96	0.83

Note: 1.00 is Annual Average of All Days Weekdays and Weekends
Data Sources: WSDOT Annual Traffic Data Report 2008 and WSDOT NW Region Data CD for 2008

The index values at all locations are similar to one another and all fall within a tight value range for all months except December, when the values drop off significantly at all locations. When December is excluded, the index values at all 14 locations range from 0.94 to 1.07, which is a range of just 0.13. Overall, the peak travel month is May. However, at individual locations, the peak occurs between the months of April and August.

During December, the daily traffic decreases dramatically relative to other months due to the Christmas and New Year's holiday periods. Also, a severe winter storm in December 2008 likely further reduced regional travel. The average index value in December is 0.84, with a range of 0.78 to 0.96. Including December, Seattle's monthly traffic volumes are relatively stable throughout the year, indicating that factors affecting travel levels remain relatively consistent throughout the year.

SEASONAL/MONTHLY VARIATIONS

Using the data CD application, WSA queried the monthly traffic volume variation at the locations noted above. To make monthly traffic volumes comparable among locations with different volume levels, the average daily volumes by month were converted to "index values" by dividing the average daily traffic volume for each month by the AADT volume at that location. Table 2-3 shows the index values for each location and month, while Figure 2-7 shows this data graphically.

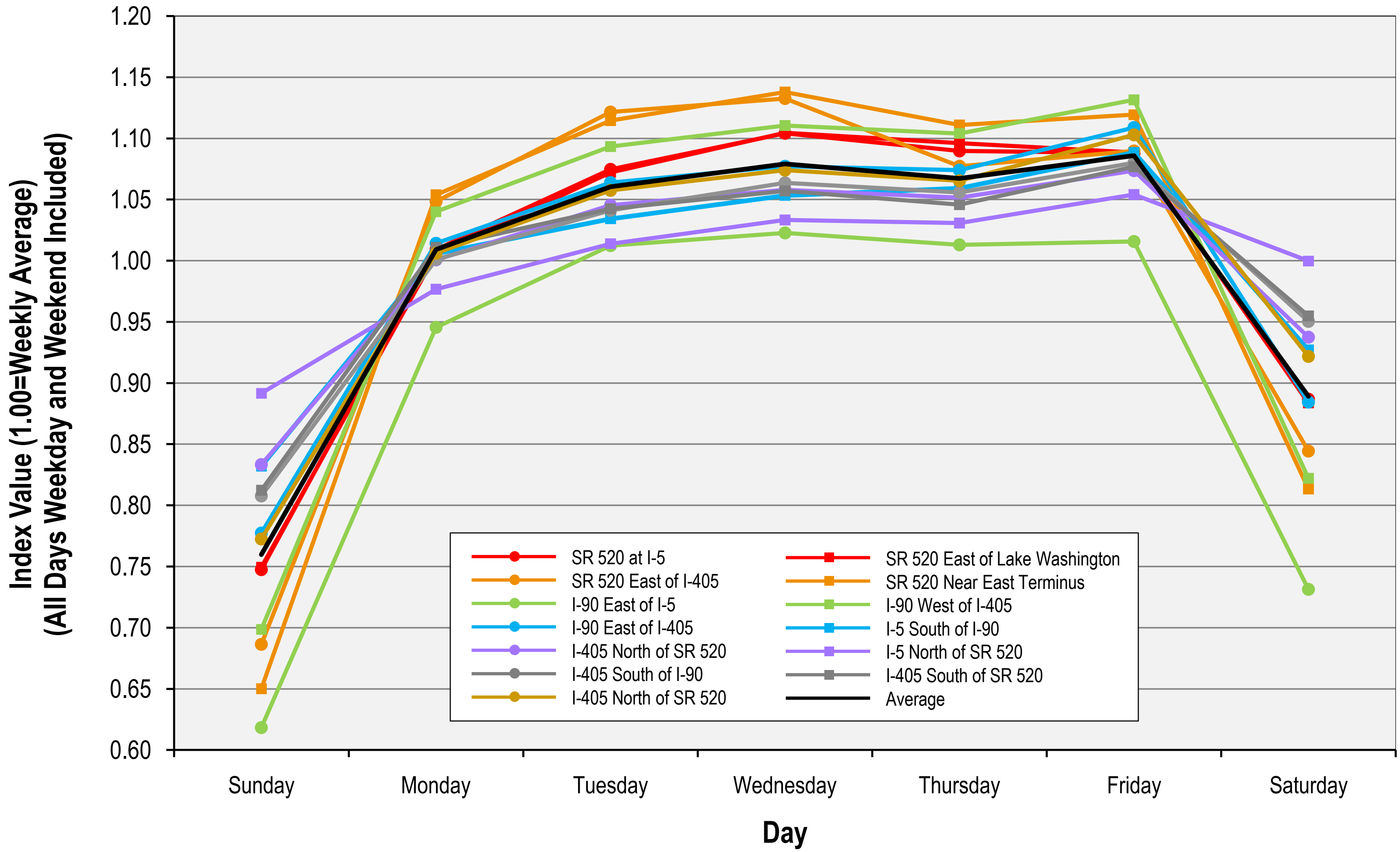
Table 2-3
Monthly Variation Index at Selected Locations

Route	Location	January	February	March	April	May	June	July	August	September	October	November	December
SR 520	At I-5	0.98	1.03	1.03	1.05	1.07	1.05	0.98	1.01	0.99	1.02	0.96	0.82
SR 520	East of Lake Washington	0.96	1.01	1.00	1.02	1.03	1.03	1.03	1.01	1.01	1.02	0.95	0.92
SR 520	East of I-405	0.98	1.03	1.03	1.06	1.06	1.04	1.02	0.99	1.02	1.03	0.94	0.81
SR 520	Near East Terminus	0.98	1.03	1.02	1.05	1.06	1.04	1.02	1.00	1.02	1.02	0.95	0.81
I-90	West of I-405	0.98	1.01	1.01	1.04	1.04	1.04	1.07	1.02	1.05	1.02	0.94	0.78
I-90	West of I-405	0.95	0.98	1.00	1.03	1.03	1.04	1.03	1.01	1.02	1.02	0.95	0.96
I-90	East of I-405	0.97	0.99	1.01	1.03	1.05	1.04	1.05	1.02	1.02	1.02	0.97	0.83
I-5	South of I-90	0.95	1.00	1.02	1.03	1.03	1.05	1.04	1.06	1.03	1.00	0.95	0.83
I-5	South of SR 520	0.94	0.98	0.98	1.03	1.04	1.05	1.05	1.06	1.03	1.02	0.97	0.84
I-5	North of SR 520	0.97	1.01	1.02	1.04	1.04	1.04	1.03	1.03	1.02	1.01	0.97	0.82
I-405	South of I-90	0.97	1.01	1.01	1.03	1.03	1.05	1.04	0.99	1.04	0.99	0.98	0.86
I-405	South of SR 520	0.98	1.03	1.04	1.06	1.02	0.97	1.00	0.96	1.04	1.03	1.01	0.85
I-405	North of SR 520	0.96	1.01	1.02	1.01	1.04	1.05	1.06	1.02	1.02	1.02	0.96	0.83

Note: 1.00 is Annual Average of All Days Weekdays and Weekends
Data Sources: WSDOT Annual Traffic Data Report 2008 and WSDOT NW Region Data CD for 2008

The index values at all locations are similar to one another and all fall within a tight value range for all months except December, when the values drop-off significantly at all locations. When December is excluded, the index values at all 14 locations range from 0.94 to 1.07, which is a range of just 0.13. Overall, the peak travel month is May. However, at individual locations, the peak occurs between the months of April and August.

During December, the daily traffic decreases dramatically relative to other months due to the Christmas and New Year's holiday periods. Also, a severe winter storm in December 2008 likely further reduced regional travel. The average index value in December is 0.84, with a range of 0.78 to 0.96. Including December, Seattle's monthly traffic volumes are relatively stable throughout the year, indicating that factors affecting travel levels remain relatively consistent throughout the year.



2008 DAILY ADT VARIATION ON MAJOR ROUTES

FIGURE 2-8

DAY-OF-WEEK/DAILY VARIATIONS

As with the monthly traffic volumes, the day-of-week volumes were converted to "index values" to make the volumes comparable among locations with different volume levels.

Table 2-4 shows index values for each location and day-of-week, while Figure 2-8 illustrates this data graphically. Figure 2-8 illustrates that day-of-week volumes at all locations follow the same general trend. Weekend volumes, particularly Sundays, are significantly lower than weekday volumes. This pattern reflects the influence of heavy commuter traffic. Weekday volumes generally build up from a low on Monday to a high (or near-high) on Friday.

Table 2-4
Day-of-Week Variation Index at Selected Locations

Route	Location	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
SR 520	At I-5	0.75	1.01	1.07	**1.10**	1.09	1.09	0.89
SR 520	East of Lake Washington	0.75	1.01	1.07	**1.10**	1.10	1.09	0.88
SR 520	East of I-405	0.69	1.05	1.12	**1.13**	1.08	1.09	0.84
SR 520	Near East Terminus	0.65	1.05	1.11	**1.14**	1.11	1.12	0.81
I-90	East of I-5	0.62	0.95	1.01	**1.02**	1.01	1.02	0.73
I-90	West of I-405	0.70	1.04	1.09	1.11	1.10	**1.13**	0.82
I-90	East of I-405	0.78	1.01	1.06	1.08	1.07	**1.11**	0.88
I-5	South of I-90	0.83	1.01	1.03	1.05	1.06	**1.09**	0.93
I-5	South of SR 520	0.83	1.00	1.05	1.06	1.05	**1.07**	0.94
I-5	North of SR 520	0.89	0.98	1.01	1.03	1.03	**1.05**	1.00
I-405	South of I-90	0.81	1.00	1.04	1.06	1.06	**1.08**	0.95
I-405	South of SR 520	0.81	1.01	1.04	1.06	1.05	**1.08**	0.95
I-405	North of SR 520	0.77	1.01	1.06	1.07	1.07	**1.10**	0.92

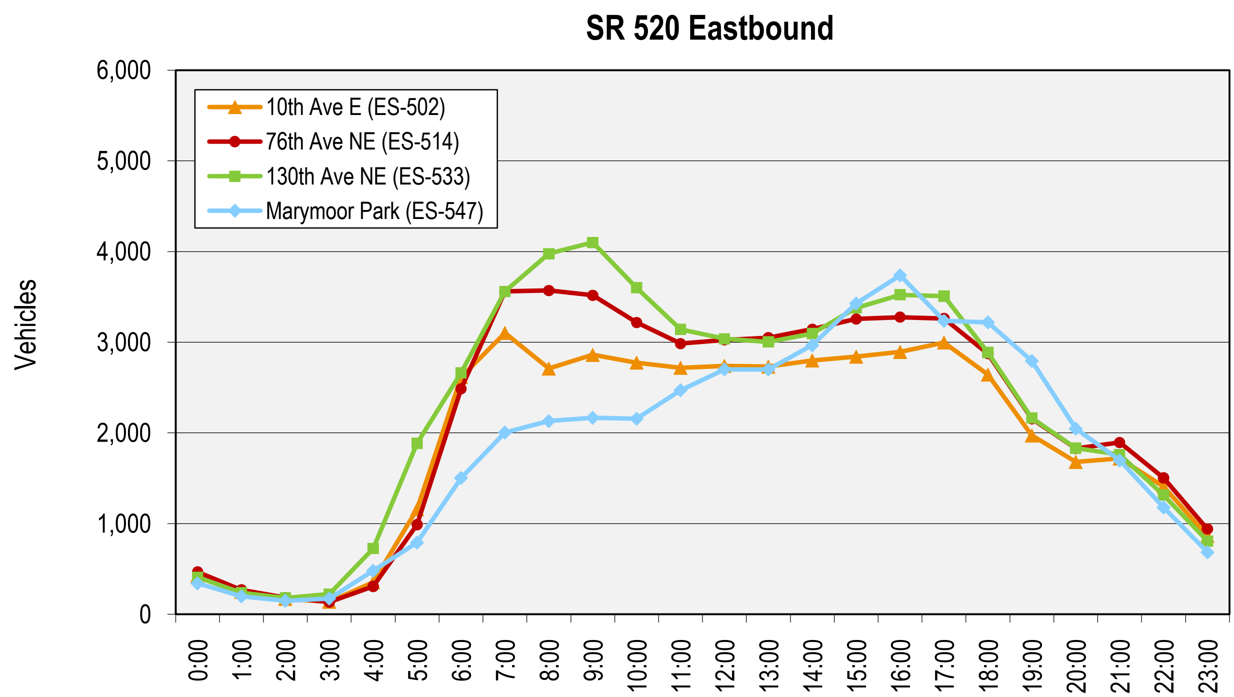
Note: 1.00 is Average of All Days of the Week
Data Sources: WSDOT Annual Traffic Data Report 2008 and WSDOT NW Region Data CD for 2008

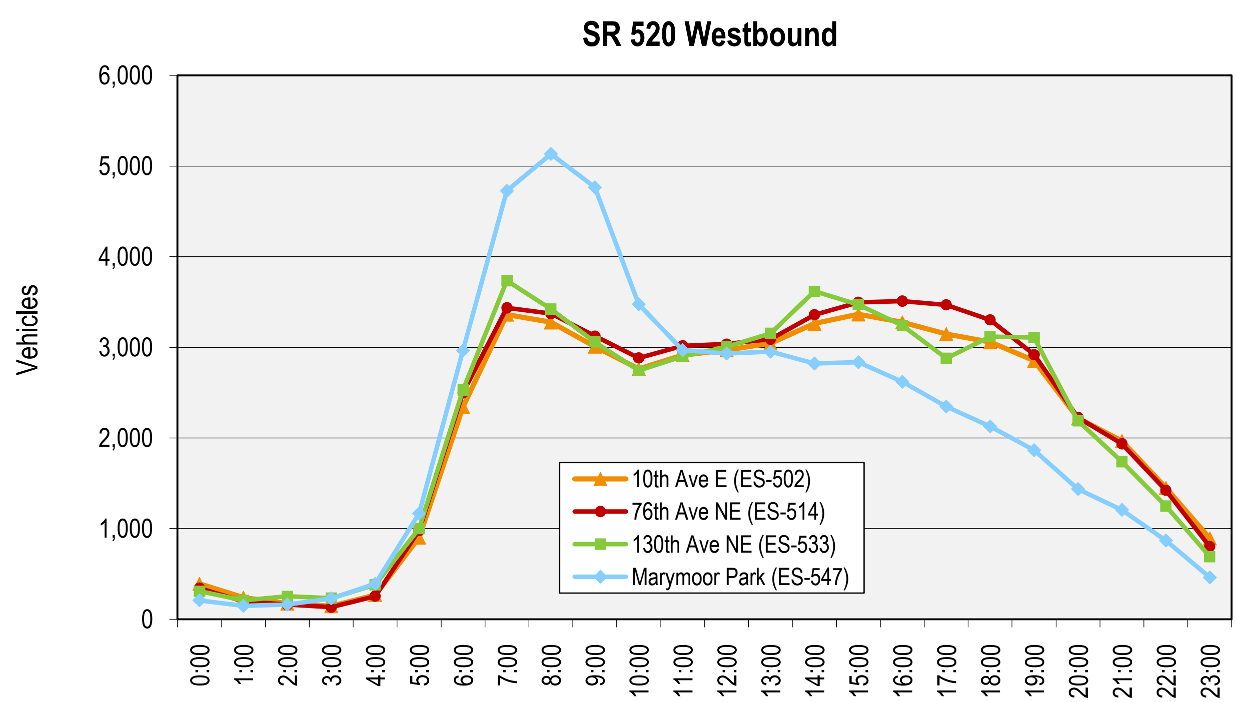
HOURLY VARIATIONS

The WSDOT loop detector data was used to review the daily traffic variation on the four major highways in the Seattle area. Information on weekday traffic patterns was extracted and is presented below.

SR 520

Figure 2-9 shows the 2008 weekday hourly traffic volumes at four locations on SR 520. The 10th Avenue and 76th Avenue locations are both west of I-405. Several atypical patterns exist in this section:





HOURLY TRAFFIC VARIATION ON SR 520 (WEEKDAY TRAFFIC ONLY FOR ALL OF 2008)

FIGURE 2-9

- Both locations have a relatively flat hourly volume profile in both directions from 7:00 am through 7:00 pm. These indicate that the section of SR 520 between I-5 and I-405 operates near or at capacity for a majority of the day. Peak period traffic has spread significantly beyond hours considered to be peak on most roadways.
- Eastbound and westbound traffic is nearly the same in both directions for the morning and afternoon peaks. During these times there are 3,500 vehicles per hour on the bridge span, indicating near equal demand for travel on both sides of the bridge. Similarly, midday volumes in both directions on the bridge span are nearly the same at 3,000 vehicles per hour.
- Westbound afternoon travel on the bridge begins peaking by 4:00 pm and lasts to 7:00 pm, a significantly long peak period.

The data from 130th Avenue NE shows the hourly weekday volume on SR 520 just east of I-405. The profile is fairly flat, but shows some increases during the morning (AM) and evening (PM) peaks. The capacity at this location is also higher due to one HOV lane in each direction.

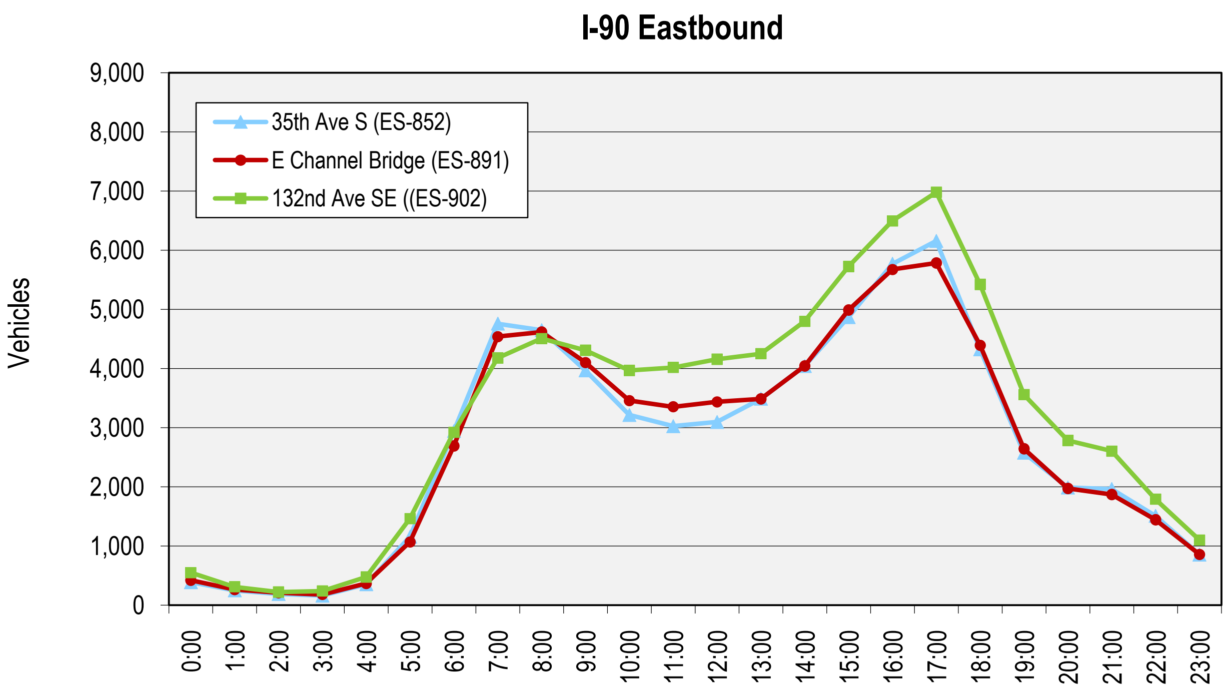
Marymoor Park is located near the east terminus of SR 520 (at NE 60th Street). The hourly volume shows a unidirectional peak (westbound peak in the AM and eastbound peak in the PM). The westbound peak is significantly higher due to the auxiliary lane availability between the West Lake Sammamish Parkway entrance and the 40th/51st Street Collector-Distributor Road, which effectively provides a fourth lane.

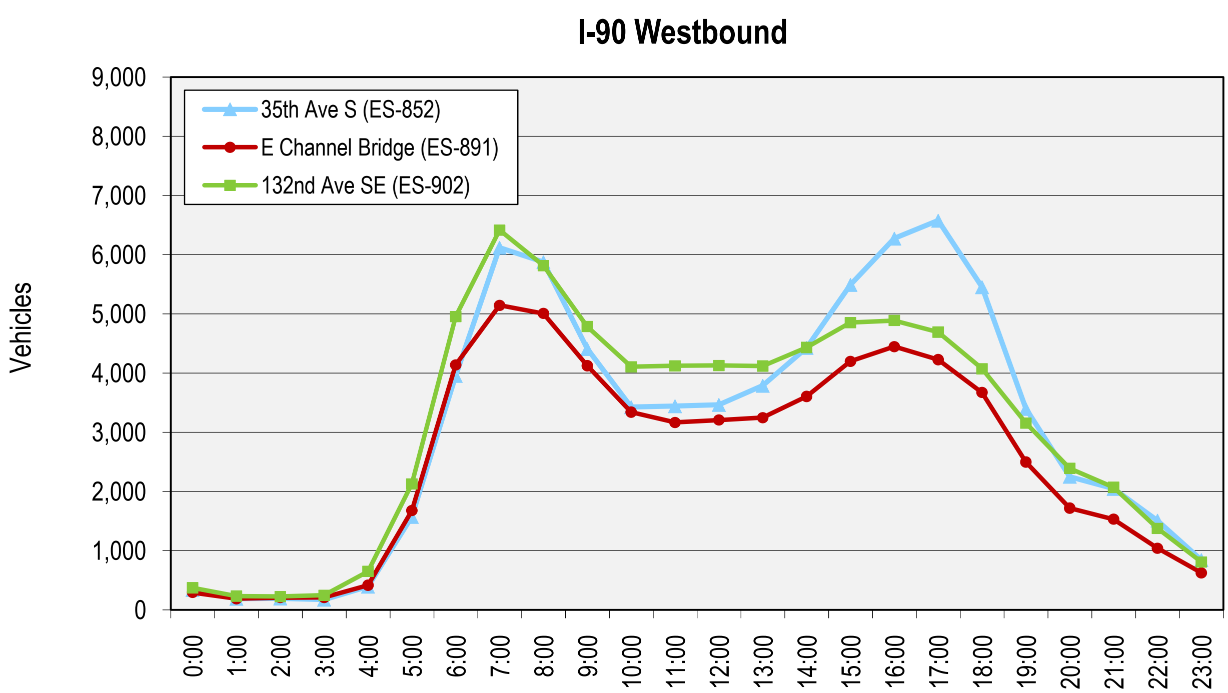
I-90

Figure 2-10 shows 2008 weekday hourly volume profiles on I-90. All three datasets show traditional AM and PM peaks with lower midday volumes. However, in the most westerly location (35th Avenue S), both directions have peaks of nearly equal magnitude during both the AM and PM peaks. By contrast, the outer roadways at the East Channel Bridge have heavier westbound AM and heavier eastbound PM peaks indicating a regular Seattle-focused commuter pattern.

I-5

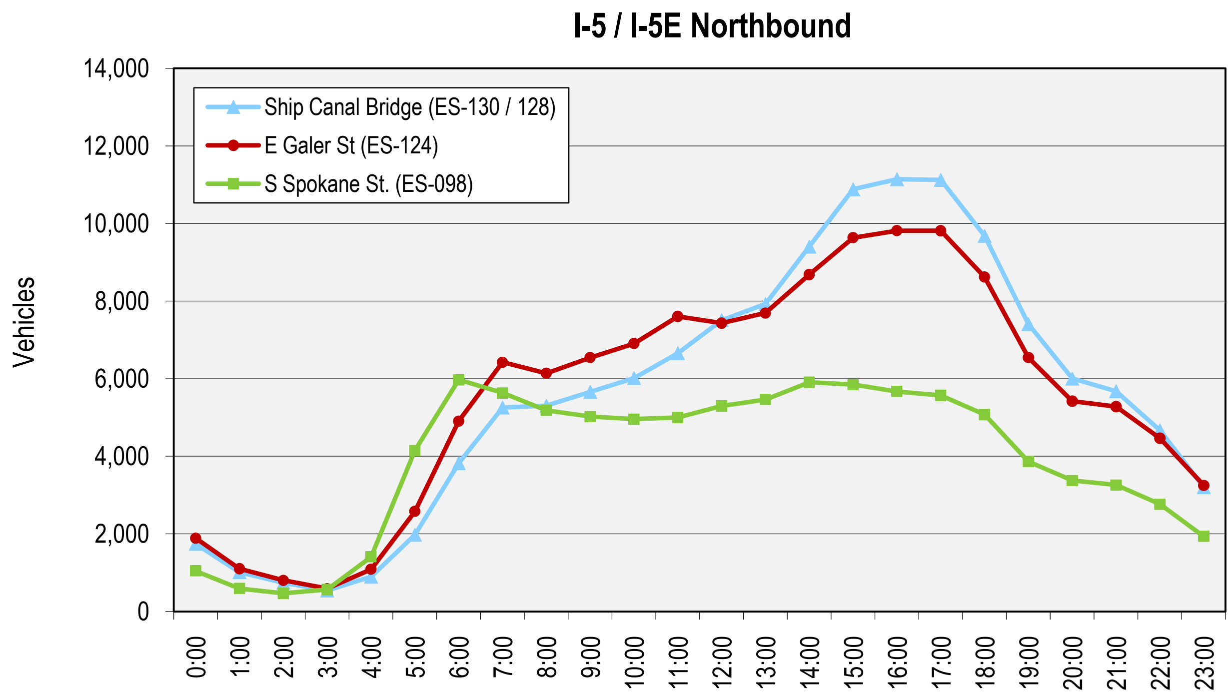
Figure 2-11 shows the 2008 weekday hourly volume profile on I-5 at three locations. The Ship Canal Bridge location is north of the interchange with SR 520, the Galer Street location is between SR 520 and downtown Seattle, and the South Spokane Street location is south of downtown Seattle and I-90. The fact that peak periods are uni-directional at the Ship Canal Bridge and Galer Street is a function of the demand and the four-lane reversible express lanes configuration.

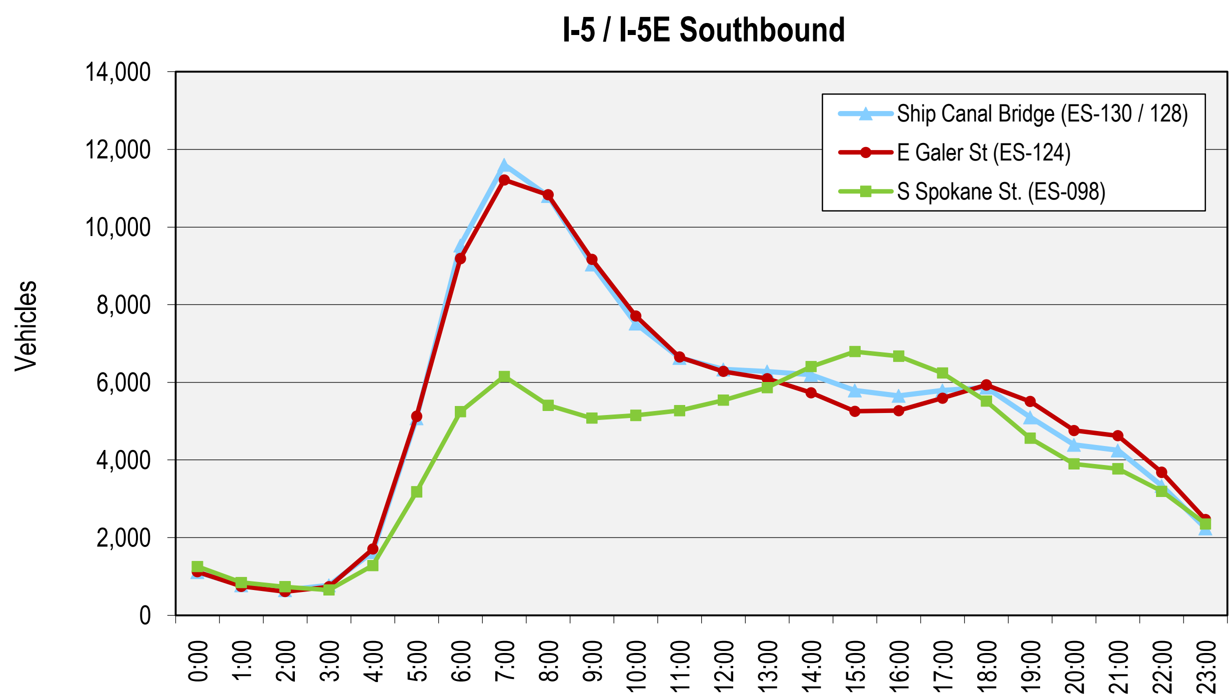




HOURLY TRAFFIC VARIATION ON I-90 (WEEKDAY TRAFFIC ONLY FOR ALL OF 2008)

FIGURE 2-10





HOURLY TRAFFIC VARIATION ON I-5 (WEEKDAY TRAFFIC ONLY FOR ALL OF 2008)

FIGURE 2-11

I-405

Figure 2-12 shows the 2008 weekday hourly volume profile on I-405 between SR 520 and I-90 at Southeast 4th Street. Both directions have fairly flat hourly volume profiles at this location. This profile indicates that this section of I-405 consistently operates near or at capacity during daylight hours, although the northbound direction volume is on average 20 percent higher. The late afternoon reduction in southbound traffic is due to a chokepoint and resulting congestion in this area combined with ongoing construction work. At NE 53rd Street, located north of SR 520 and downtown Bellevue, a regular commuting pattern can be observed with southbound traffic heavier in the morning and northbound traffic heavier in the evening. At SE 47th Street, located well south of SR 520, downtown Bellevue, and I-90, traffic flow northbound toward Bellevue is flat most of the day, although significantly lower than SE 4th Street. Southbound traffic at this location shows an afternoon peak, indicating a southbound commute pattern from Bellevue.

Percentage of Traffic by Time Period

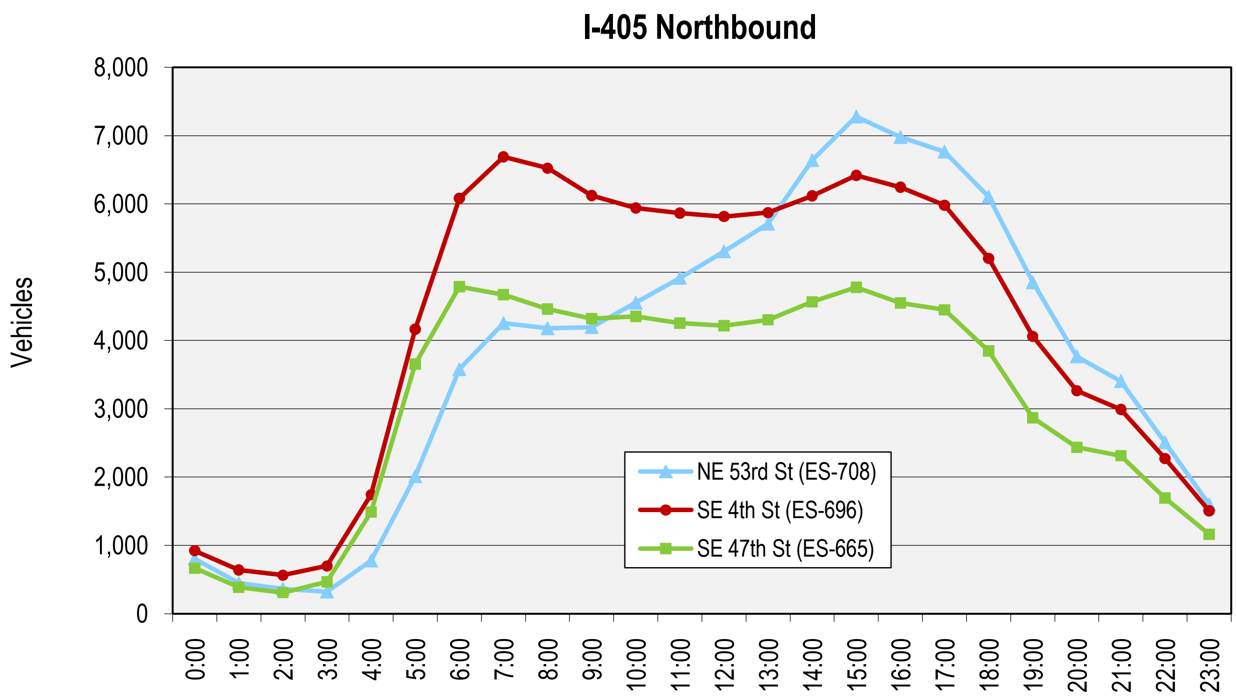
Table 2-5 provides the 2008 peak hour percentage of weekday daily traffic occurring in each period. Most of the locations have a peak volume in one of the peak-periods. However, some locations, including much of SR 520, have very small variation between peak hour percentage indicating traffic at or near capacity for most of the day.

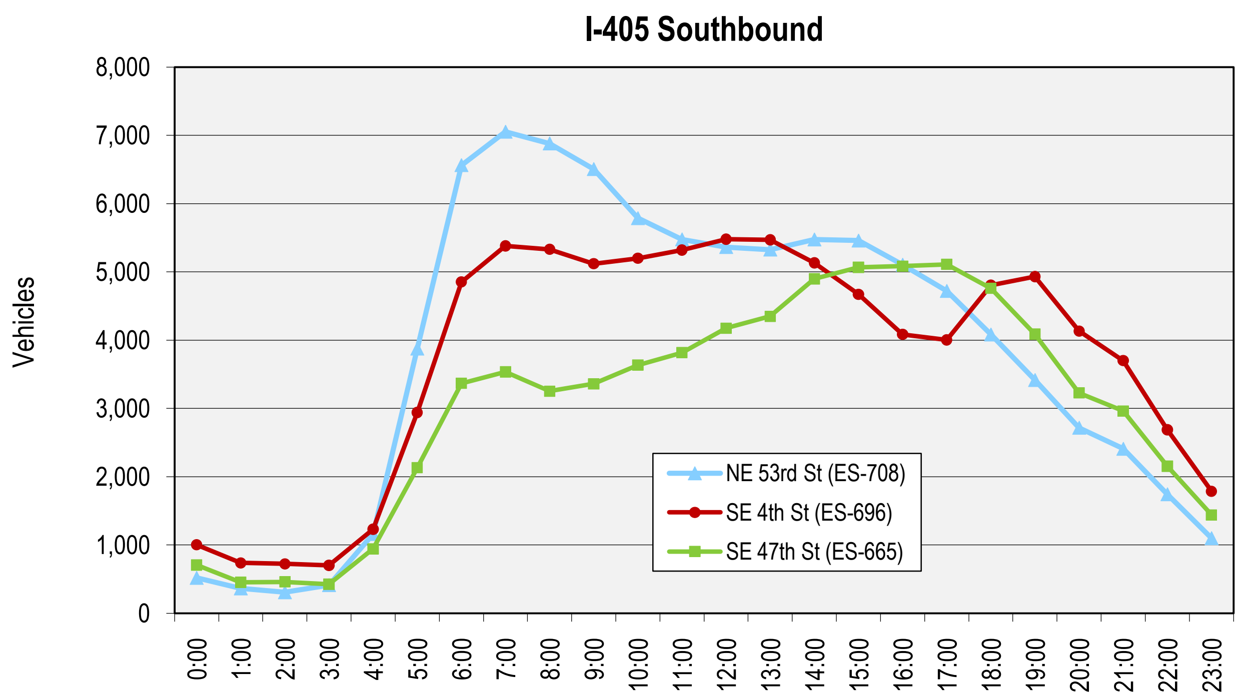
WSA Supplemental Counts

WSA hired Quality Counts, Inc. to perform supplemental traffic counts at a total of eight ramps located amongst three interchanges on the western half of SR 520. The locations were the following:

- Montlake Boulevard (two ramps)
  - Westbound exit
  - Eastbound entrance
- Lake Washington Boulevard (two ramps)
  - Westbound exit
  - Eastbound entrance
- Bellevue Way
  - Westbound entrance ramp from northbound Bellevue Way
  - Westbound entrance ramp from southbound Bellevue Way
  - Eastbound exit ramp to northbound Bellevue Way
  - Eastbound exit ramp to southbound Bellevue Way

These counts covered a Tuesday and Wednesday in early November 2009. The average results of the two days was used for comparison against WSDOT data. The period of the counts was from 6:00 am to 10:00 pm.





HOURLY TRAFFIC VARIATION ON I-405
(WEEKDAY TRAFFIC ONLY FOR ALL OF 2008)

FIGURE 2-12

WSA compared the supplemental counts with the 2008 average weekday counts from WSDOT count stations; general consistency was observed at all but one ramp location. The exception occurred on the ramp from northbound Bellevue Way to westbound SR 520. This difference may be due to the positioning of the count loops on the ramp as this ramp diverges to one single occupancy vehicle (SOV) and one HOV lane. Table 2-6 provides the summary of the comparison.

Table 2-5
Observed Peak Hour Share of Average Weekday Traffic by Periods

Route	Location	Direction	AM	Midday	PM
I-405	NE 53rd St	NB	5%	8%	8%
		SB	8%	6%	6%
	SE 47th St	NB	6%	6%	6%
		SB	5%	7%	7%
	SE 4th St	NB	7%	6%	6%
		SB	6%	6%	5%
I-5	S Spokane St	NB	6%	6%	6%
		SB	6%	7%	7%
	E Galer St	NB	5%	7%	7%
		SB	9%	6%	5%
	Ship Canal Bridge	NB	4%	8%	8%
		SB	9%	6%	5%
I-90	132nd Ave SE	EB	6%	7%	9%
		WB	9%	6%	7%
	35th Ave S	EB	7%	7%	9%
		WB	8%	7%	9%
	E Channel Bridge	EB	7%	8%	9%
		WB	8%	7%	7%
SR 520	10th Ave E	EB	7%	6%	6%
		WB	7%	7%	6%
	130th Ave NE	EB	7%	7%	6%
		WB	7%	7%	6%
	76th Ave NE	EB	7%	6%	6%
		WB	6%	7%	7%
	Marymoor Park	EB	5%	8%	8%
		WB	10%	7%	5%

Data Sources: WSDOT Annual Traffic Data Report 2008 and WSDOT NW Region Data CD for 2008

Table 2-6
Percentage Difference in Ramp Counts - WSA versus WSDOT

Ramp Location	Percent Difference WSA vs. WSDOT		
	7:00 am -9:00 am	11:30 am -12:30 pm	4:00 pm - 6:00 pm
520 EB from Montlake	0.1%	0.8%	-3.9%
520 WB to Montlake	0.4%	-0.8%	0.8%
520 EB from Lake Wa Blvd	-2.6%	-0.5%	-1.5%
520 WB to Lake Wa Blvd	1.4%	1.2%	8.7%
520 WB from Bellevue Way SB	-1.5%	0.9%	-1.9%
520 WB from Bellevue Way NB	-17.4%	10.0%	-21.7%
520 EB to Bellevue Way NB	0.2%	13.9%	-1.0%
520 EB to Bellevue Way SB	0.5%	14.2%	0.2%

VEHICLE CLASSIFICATION COUNTS

Table 2-7 shows the results of the classification counts on SR 520 conducted in November 2009 by Quality Counts, Inc.

Due to the number of transit buses using SR 520, transit vehicles have been broken out separately. This class includes all standard public transit buses traveling the corridor from King County Metro, Sound Transit, and Community Transit. Transit buses make up about 1.1 percent of the overall bridge traffic, reaching highs of 1.8 percent of all traffic during peak hours. During off-peak times, the proportion of transit making up the SR 520 traffic flow drifts down to 0.5 percent. Morning and afternoon peaks are the peak hours for transit buses.

Table 2-7
SR 520 Classification Counts Summary

Time Period	Percentages by Time Periods				
	Passenger Vehicles	Transit Buses	Other Buses	Medium Trucks	Heavy Trucks
AM Peak	96.4%	1.7%	0.5%	1.0%	0.4%
PM Peak	97.1%	1.8%	0.4%	0.6%	0.1%
All Day	97.0%	1.1%	0.3%	1.3%	0.4%

Trucks (other than public transit buses) make up about two percent of the total traffic stream. This includes privately-operated bus systems (such as the Microsoft Connector service), delivery vans, multiple unit trucks, and other large trucks. The largest proportion of trucks is the medium truck category (Federal Highway Administration (FHWA) Class 5, two-axle single-unit trucks), which is about 1.3 percent of the entire traffic stream. Unlike transit traffic, truck traffic peaks somewhat later in the morning (around 10:00 am) and holds steady through noon. Truck traffic drops after 1:00 pm, decreasing throughout the rest of the study period except for a minor peak in the evening after the afternoon rush dies down. By direction, truck traffic westbound in the mid-morning is stronger than the eastbound traffic, but spread out over several hours. In the afternoon, westbound traffic drops off significantly, but eastbound truck traffic shows a characteristic peak. These figures make sense as truck drivers try to avoid peak congested periods. About 0.4 percent of the observed traffic was heavy trucks (three-axle and up). The total amount of truck traffic on SR 520 compared to most major highways is relatively low.

WSDOT vehicle classification information is very limited for this specific corridor. However, a rough collection is available using loop occupancy and speed characteristics as well as classification by length, instead of number of axles and other vehicle characteristics. Table 2-8 provides a summary.

This data indicates that SR 520 carries fewer non-passenger vehicles as a proportion of overall traffic.

Table 2-8
SR 520 Vehicle Classification Summary by Vehicle Length

Route	Vehicle Classes by Length (feet)			
	0 - 20	20+ - 40	40+ - 60	60+
SR 520	95% to 98%	1% to 3%	<1% to 1%	<1%
I - 90	94% to 96%	2% to 5%	1% to 1.5%	<1%

Data source: Washington State Department of Transportation

TRAVEL TIME & SPEED

WSA performed travel time surveys along important routes that could be potential alternatives to SR 520 for major movements. To capture the travel speed and travel time data, a probe vehicle was outfitted with a Global

Positioning System (GPS) device to record the vehicle's speed and position every two seconds. The travel time and speed data was collected along the following six corridors in the region:

1. Seattle - Bellevue using SR 520 bridge
2. Seattle - Bellevue using I-90 bridge
3. Seattle - Woodinville using SR 522
4. Bellevue - Woodinville using I-405
5. Seattle - Redmond using SR 520
6. I-5/I-90 interchange to I-405/I-90 interchange using I-5 and I-405 (south of Lake Washington)

These surveys were conducted in early November 2009 on Tuesdays through Friday mornings. Morning surveys were conducted from approximately 7:00 am to 10:30 am and evening surveys from approximately 3:30 pm to 7:30 pm. At least three runs per direction per time period were conducted for the rectangle formed by SR 520, I-90, I-405, I-5 around Lake Washington. At least two runs per direction per time period were conducted for other routes.

In addition to WSA travel time surveys, WSDOT also provided travel time information based on in-pavement detectors for 2008.

ROUTE TRAVEL TIMES

Table 2-9 below shows the travel times along the above corridors. This information was used for the calibration of the travel demand model. The travel time between Seattle and Bellevue indicates a three to four minute difference between SR 520 and I-90. For the data collected, the travel times using I-90 (and the connecting I-5 and I-405 sections) between the two city centers appear to be less than travel times using SR 520 (and the connecting I-5 and I-405 sections) with the exception of the PM peak in the westbound direction where the route choice using SR 520 appears to perform better than the route choice using I-90. While SR 520 westbound is often severely congested in the evenings, the connecting portions of I-5 and I-405 typically function moderately well. The connecting portions of I-5 and I-405 which use the I-90 route are often very congested. Consequently, it is possible that while the SR 520 routing involves a lot of congestion on SR 520 itself, the combination of I-90 westbound in the evening being limited to three lanes and the congestion on connecting routes can result in the I-90 routing being slower. Of course, with the day-to-day fluctuations of traffic and the many segments of highway involved in the comparison, the quicker routing can easily shift from day to day.

The Seattle-Woodinville corridor showed higher travel time in the AM southbound and PM northbound directions indicating commuters to downtown Seattle. A similar pattern was seen in the Bellevue-Woodinville corridor indicating commuters to downtown Bellevue. The Seattle-Redmond corridor indicated less directionality, due to strong employment draws in downtown Seattle and in western Redmond where Microsoft is headquartered, as well as high residential concentrations in both Seattle and Redmond.

Table 2-9
Observed Travel Time for Peak Periods (2009)

Route	Direction	Travel Time in Minutes	
		AM	PM
1. Seattle - Bellevue using SR 520 Bridge	EB	16.0	18.0
	WB	15.0	18.0
2. Seattle - Bellevue using I-90 Bridge *	EB	13.0	15.0
	WB	13.0	22.0
3. Seattle - Woodinville using SR 522	NB	28.0	39.0
	SB	30.0	33.0
4. Bellevue - Woodinville using I-405	NB	10.8	20.0
	SB	16.5	10.2
5. Seattle - Redmond using SR 520	EB	19.0	22.5
	WB	20.2	21.7
6. I-5/I-90 to I-405/I-90 using I-5 and I-405 (south part)	EB	36.5	31.5
	WB	36.0	35.0

* Reversible lanes in effect: Westbound in AM peak and eastbound in PM peak

The times shown above represent point-to-point travel on the freeway, and do not include access time to and from the highway, interchange, intersection, or traffic signal wait times.

Data Source : WSA Travel Time Survey, November 2009

Travel Speeds on East-West Routes

Figures 2-13 through 2-16 show travel speeds, captured via GPS using a probe car, on area highways.

SR 520 — Eastbound

The eastbound AM speed map (Figure 2-13) indicates that eastbound SR 520 is very congested between I-5 and the western high-rise bridge. Travel across the floating bridge generally flows at the speed limit of 50 mph or faster during off-peak periods and sometimes slows to the 40-45 mph range during peak periods, unless there is an incident on the bridge or eastern approach roadway. Traffic generally slows in the vicinity of Evergreen Point Freeway station due to buses entering and exiting the traveled way. Speeds are generally at or near free-flow from Bellevue Way to the end of SR 520.

During the afternoon peak, congestion at the western end of SR 520 is slightly better. However, there is still significant congestion from Lake Washington Boulevard to the western high-rise bridge. There is heavy congestion on the east end of SR 520, from NE 51st Street to the Avondale Road intersection at the end of SR 520, caused by arterial intersections and lower capacity roadways.

SR 520 — WESTBOUND

During the AM peak, westbound speeds generally range from 30 mph to more than 60 mph. The two areas of congestion are: (1) on the east end between Avondale Road and West Lake Sammamish Parkway due to continued construction of new ramps and lanes in this area, and (2) between Bellevue Way and the SR 520 bridge, due to the HOV lane drop prior to the bridge. Travel in the westbound direction during the PM peak is severely congested from east of I-405 to the SR 520 bridge, and continues to be moderately congested all the way to I-5, except for a small section between the western high-rise bridge and Lake Washington Boulevard.

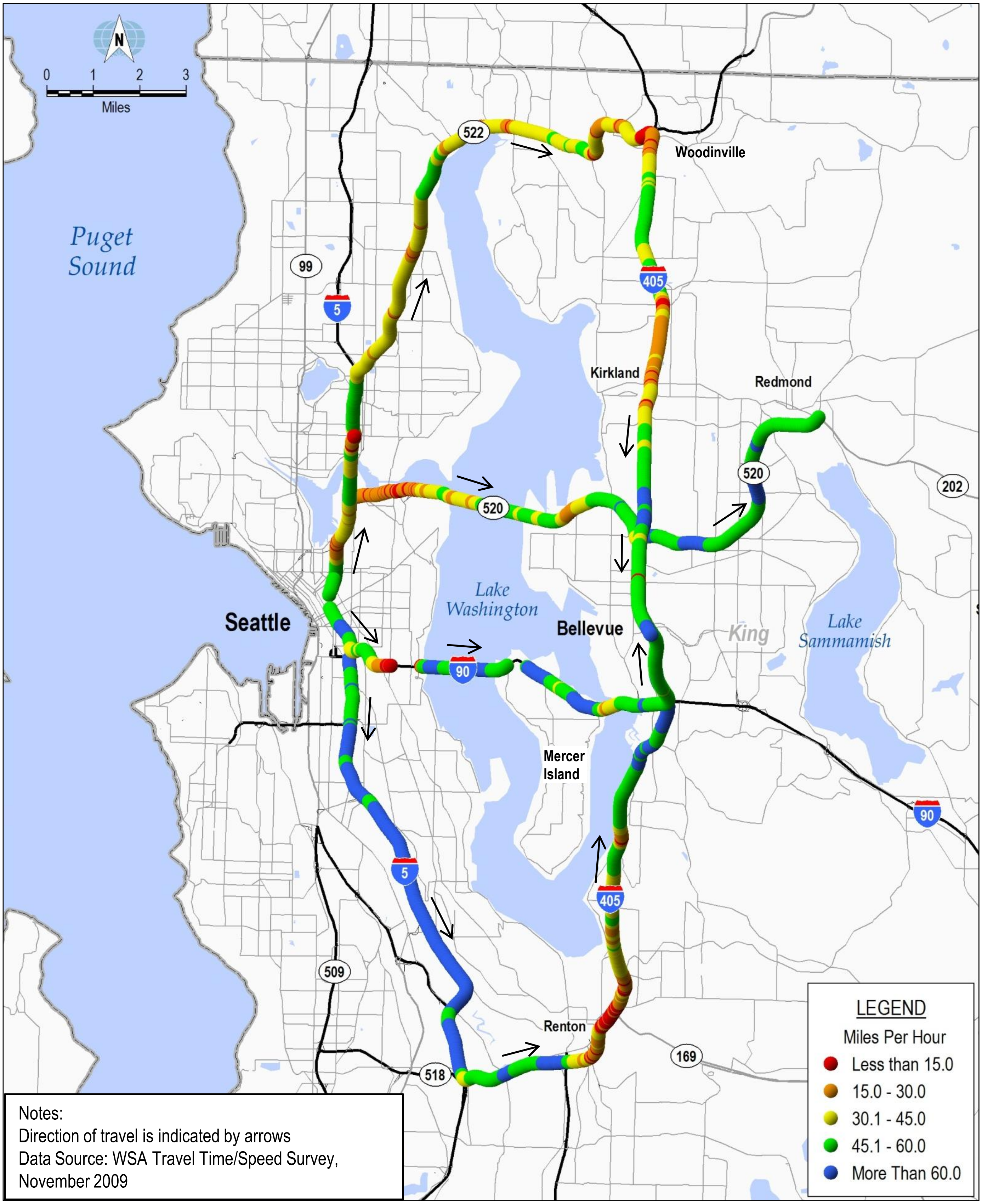
SR 522

SR 522 is a signal-controlled arterial with speed limits ranging from 30 to 45 mph. The route contains no sections of prolonged delays, but speeds are generally lower than on limited-access routes and range between 15 and 45 mph.

The westbound direction shows notably more delays in the morning than the eastbound direction due to traffic using this route to access downtown Seattle and the University of Washington. In the afternoon peak, both directions have similar speeds with the eastbound being minimally slower.

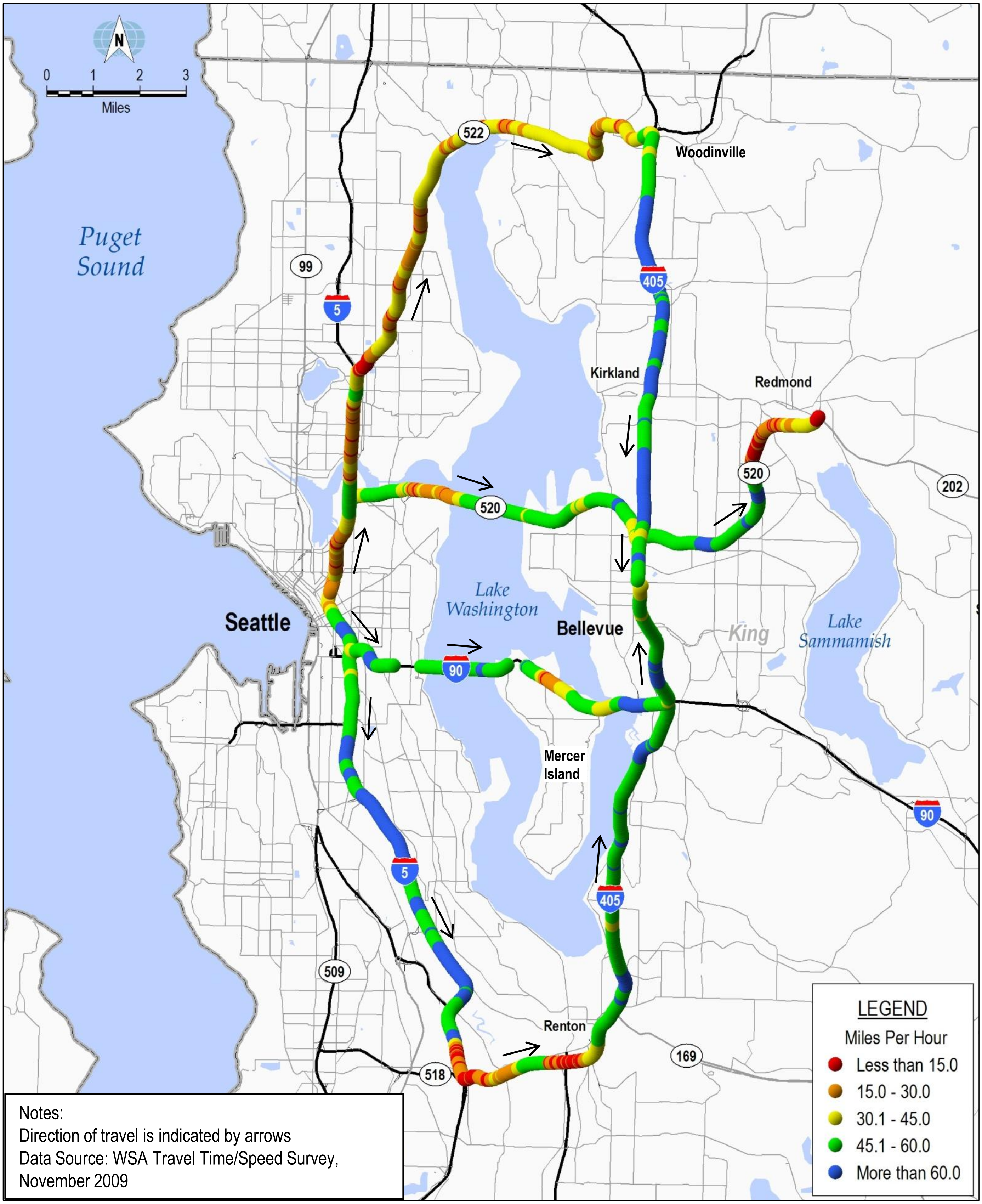
I-90

Traffic on I-90 moves at much higher speeds compared to SR 520 and SR 522. The section of I-90 between I-5 and the Mt. Baker Tunnel has congestion in both directions during the AM peak. During the PM peak there is congestion in both directions in the Mercer Island area.



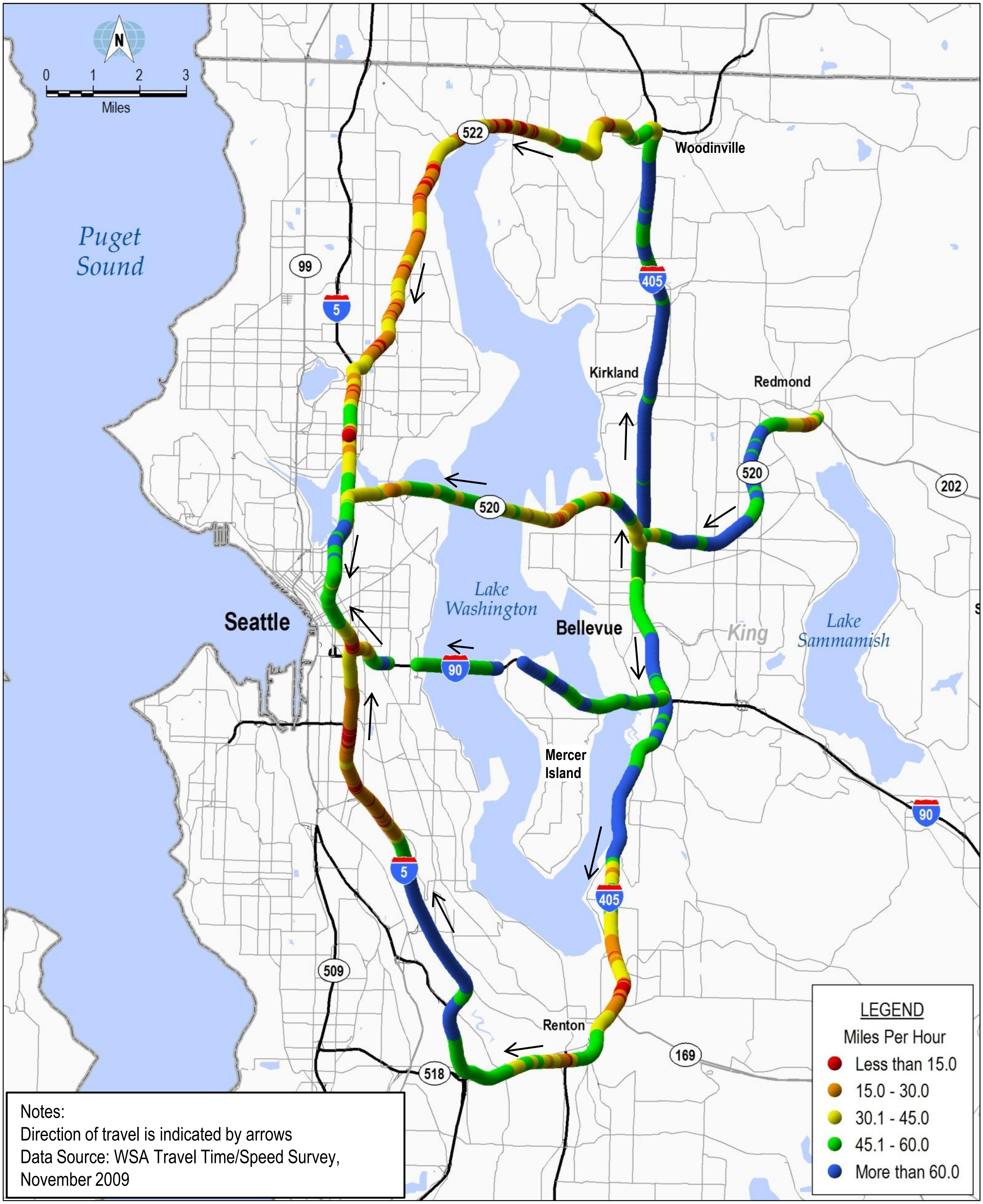
OBSERVED AVERAGE TRAVEL SPEED – EASTBOUND AM PEAK

FIGURE 2-13



OBSERVED AVERAGE TRAVEL SPEED – EASTBOUND PM PEAK

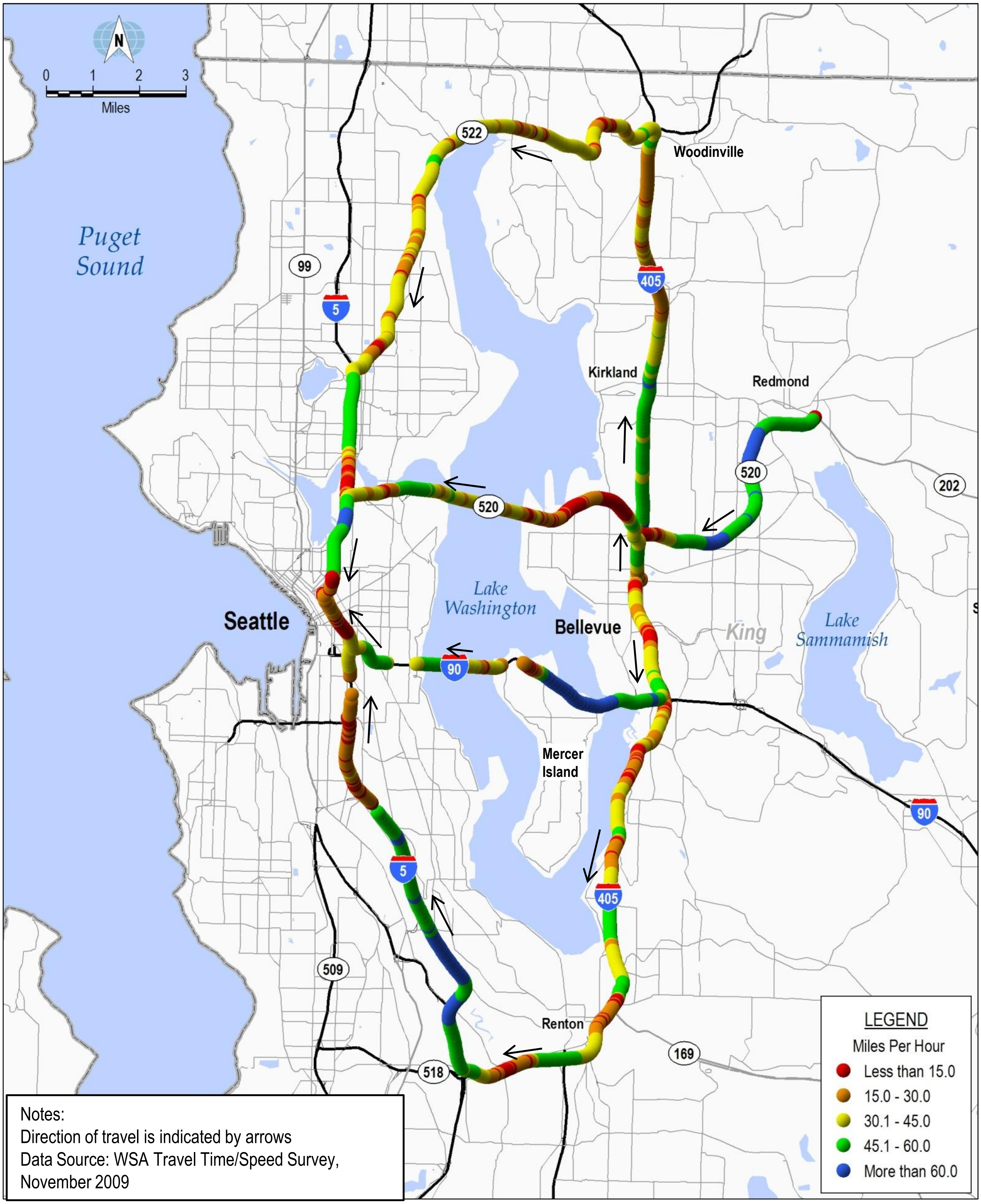
FIGURE 2-14



Notes:
Direction of travel is indicated by arrows
Data Source: WSA Travel Time/Speed Survey, November 2009

OBSERVED AVERAGE TRAVEL SPEED – WESTBOUND AM PEAK

FIGURE 2-15



OBSERVED AVERAGE TRAVEL SPEED – WESTBOUND PM PEAK

FIGURE 2-16

EXISTING TRANSIT SERVICES IN THE STUDY AREA

Currently, there are four agencies that operate transit routes across the SR 520 bridge. The overall scope of services of each agency are summarized below:

- King County Metro Transit: This agency is a division of the King County Department of Transportation, and is the primary transit provider in the greater Seattle metropolitan area with a service area of 2,134 square miles. It operates a fleet of approximately 1,300 vehicles on 223 routes, which serve an annual ridership of 112 million. Metro began operations in 1973, but can trace its roots back to the Overlake Transit Service which was founded in 1927.
- Community Transit: Community Transit is the main public transit authority of Snohomish County. It operates buses within Snohomish County and downtown Seattle, the University of Washington, and Seattle's Eastside suburbs in King County (e.g., Woodinville and Overlake). Community Transit began service in 1976. Community Transit operates 269 vehicles on 30 local and 23 commuter bus routes, and has an annual ridership of approximately 9.6 million.
- Central Puget Sound Regional Transit Authority: Better known as Sound Transit, this agency serves King, Snohomish, and Pierce Counties, which is a much larger service area than the two agencies listed above. Sound Transit was formed in 1996 to operate express bus, commuter rail, and light rail services as well as capital funding for many transit lines, transit centers, HOV direct access lanes, and park & ride facilities. In November 2008, voters approved increasing the sales tax in the Sound Transit District to fund a 15-year package of light rail, commuter rail, express bus, and other mass transit expansions including the addition of light rail across the I-90 Bridge. The agency had an annual ridership of more than 22 million in 2010. Sound Transit operates three transit modes:
    - ST Express Bus: The agency operates a fleet of 227 buses on 25 express bus routes throughout the Tri-County area.
    - Sounder Commuter Rail: The agency also operates two commuter rail lines, known as “Sounder,” between Seattle-Tacoma and Seattle-Everett.
    - Light Rail: The agency operates two light rail links. The Tacoma Link operates between the Tacoma Dome Station and downtown Tacoma. The Central Link fully opened in December 2009 and operates between downtown Seattle and SeaTac Airport.
- Metro School: Limited service operated to serve some private school facilities.

BUS ROUTES OPERATING ON SR 520 BRIDGE

As Table 2-10 shows, there are three transit operators and a total of 26 bus routes that utilize the SR 520 bridge. Prior to new service implementation in October 2010 and February 2011, 614 bus trips crossed the SR 520 bridge each weekday. Service increases on SR 520 were implemented in 2010 and 2011 due to increasing demand and the Urban Partnership Agreement. As of spring 2011, 758 bus trips cross the SR 520 bridge each weekday: 387 eastbound trips and 371 westbound trips.

Table 2-10
Bus Routes Operating on SR 520

Transit Operator	No. of Routes	Route Numbers	No. Runs Per Weekday
King County Metro Transit	20	167, 242, 243, 250, 252, 255, 256, 257, 260, 261, 265, 266, 268, 271, 272, 277, 280, 311, 982, 986	438 (56%)
Sound Transit	5	540, 542, 545, 555, 556	324 (43%)
Community Transit	1	424	6 (1%)
Total	**26**	-	**758**

However, only three of the routes operate throughout the day, seven days a week: Metro Route 255, Metro Route 271 and Sound Transit Route 545. The Sound Transit 540 route operates all day on weekdays. The remainder operate only during peak periods (plus one overnight route, Metro Route 280). Over 70 percent of all weekday bus crossings occur among five routes: the four “all day” routes plus Sound Transit Route 542.

As shown in Table 2-11, on the Seattle side of SR 520, 54 percent of all bus trips (via SR 520) start or end in the Seattle central business district, and 41 percent start, stop in, or end in the “University District” (located just north of SR 520). The remaining five percent of the bus trips start or end in northern Seattle. The routes go to a far wider range of destinations on the east side of the SR 520 bridge: going as far south as Renton, as far north as Snohomish, and as far east as Duvall. However, based on the number of scheduled buses per weekday, the most popular east side start/stop in/end locations are in Redmond (37 percent of all buses via SR 520), Overlake (5 percent direct plus 10 percent stop in), Kirkland (28 percent), and Bellevue (12 percent direct plus 13 percent stop in). With the introduction of tolls on the SR 520 bridge, some drivers are likely to mode-shift to transit routes that use the SR 520 bridge. This would increase the already important role of transit on the bridge.

Table 2-11
Bus Routes Operating on SR 520 - Destinations

Origin/Destination	Proportion Of All Bus Routes Trips Using SR 520 on Weekdays
West Side of Lake Washington:	
Seattle	54%
University District	31% direct plus 10% stop in
North Seattle	5%
East Side of Lake Washington:	
Redmond	35%
Overlake	4% direct plus 10% stop in
Kirkland	31%
Bellevue	12% direct plus 13% stop in

WSA evaluated additional information regarding bus crossings and transit ridership on the SR 520 bridge. (This data covers all of the SR 520 cross-lake bus trips by Metro and Sound Transit, but does not include the less than one percent of cross-lake trips by Community Transit.) As of Spring 2011, there are approximately 6,500 peak direction seats provided across the lake in each peak period (westbound 6:00 am to 9:00 am and eastbound 3:00 pm to 6:00 pm). In the off-peak direction, approximately 2,900 seats are provided in each period. There are approximately 18,800 total peak period seats and approximately 36,000 total daily seats. Currently, there are about 16,000 transit trips per weekday across the bridge. While many buses do not have all seats filled, other buses include standing patrons during peak periods. Consequently, there is room for additional weekday transit crossings without service expansion. Also, daily capacity on the buses varies by the type of bus available due to different bus types, but the number of bus crossings remains the same.

From October 2010 to February 2011, average weekday ridership across the bridge was about 15,600 passengers. Of this amount, about 9,100 are peak period passengers. Summer 2010 data shows about 14,600 average weekday riders crossing SR 520. In contrast, during summer 2008 when gas prices spiked but before the national recession had a major effect on employment in the Seattle area, about 16,000 riders crossed the lake on buses on average weekdays.

The number of SR 520 bridge bus and bus passenger crossings show there is a significant demand for travel across the bridge that is served by the transit system. However, stated preference survey results discussed later in this report suggest the vast majority of trips will not shift to transit based on the tolling of SR 520.

TRAVEL PATTERN SURVEYS

As part of this study effort, a Travel Pattern Survey was conducted in September 2009. Survey cards with prepaid return postage were sent to more than 43,000 drivers. More than 6,400 survey cards were returned within the acceptance period, of which 93 percent were usable based on validity criteria.

The travel patterns observed from the survey served as integral inputs into the travel demand model used for the SR 520 bridge traffic and toll revenue forecasts. The key findings of the Travel Pattern Survey are summarized below.

Methodology And Procedures

The names and addresses of potential respondents were gathered by identifying license plate numbers of vehicles driving across the SR 520 bridge in June 2009. The name and address on the vehicle's registration were then retrieved from the Washington State Department of Licensing.

The survey instrument was a 9" high by 12" wide survey card in two panels separated by a perforation. One panel contained the outbound address and survey instructions, while the other panel contained the questionnaire itself and the return mailing address with prepaid postage. After completing the survey, respondents were instructed to tear the card on the perforation and return only the portion with the questionnaire/return address.

The questionnaire side of survey card is shown in Figure 2-17. The survey contained 10 questions, plus a space for respondents to provide an e-mail address through which they would be invited to participate in the SR 520 stated preference survey (conducted as part of this study). Respondents were asked to describe a recent eastbound trip across the SR 520 bridge. The first three questions on the survey were the primary information de-

Washington State Route 520 — Travel Pattern Survey — 2009

INSTRUCTIONS – PLEASE TELL US ABOUT THE MOST RECENT WEEKDAY TRIP YOU TOOK ON THE SR 520 BRIDGE. ALL RESPONSES SHOULD BE FOR A WEEKDAY TRIP IN THE EASTBOUND DIRECTION ONLY.

A. Please indicate the time period in which you began this one-way eastbound weekday trip. (Circle one)

1. 6:00 am to 9:00 am
2. 9:00 am to 3:00 pm
3. 3:00 pm to 6:00 pm
4. 6:00 pm to 10:00 pm
5. 10:00 pm to 6:00 am

B. Where did you begin this one-way eastbound weekday trip?
Please be as specific as possible (e.g., nearest intersection, street address, airport, shopping malls, etc.).

Street Address, Nearest Intersection or Major Landmark

City | State | Zip Code (if known)

C. Where did this one-way eastbound weekday trip end?
Your answer should not be the same as the answer given in Question B.

Street Address, Nearest Intersection or Major Landmark

City | State | Zip Code (if known)

D. Please indicate the main purpose of your one-way trip on the SR 520 Bridge. (Circle one)

1. Going to work
2. Returning from work
3. Company business
4. Vacation/Recreational
5. Shopping
6. School
7. Social/Friends
8. Medical or other personal business

E. How many times per week do you make this trip on the SR 520 Bridge in the eastbound direction? (Circle one)

Fewer than 1 | 1 | 2 | 3 | 4 | 5 | 6 or more

F. How many people, including yourself, were in your vehicle? (Circle one)

1 | 2 | 3 | 4 | 5 | 6 or more

G. Please identify the type of vehicle you were driving. (Circle one)

1. Passenger Car, SUV or Pickup Truck
2. Truck
3. Other Vehicle (inc. Motorcycle, RV, Bus)

H. Please provide your home zip code. ______________________

I. Please identify the interchange at which you entered Eastbound SR 520. (Circle one)

1. I-5 (Northbound)
2. I-5 (Southbound)
3. Montlake Blvd. E
4. Lake Washington Blvd. E

J. Please identify the interchange at which you exited Eastbound SR 520. (Circle one)

1. 84th Avenue NE
2. Bellevue Way NE
3. I-405 Northbound
4. I-405 Southbound
5. 124th Avenue NE
6. 148th Avenue NE
7. 40th / 51st Street NE
8. W. Sammamish Pkwy NE
9. Redmond Way
10. Avondale Road NE

East terminus of SR 520

WIN A $100 GIFT CARD!

You will automatically be entered in a drawing to win one of twenty $100 Starbucks® Gift Cards by completing this Travel Pattern Survey and including your e-mail address below. You may also be invited by e-mail to participate in a more detailed survey regarding the SR 520 Bridge. Your e-mail address will not be used for any purpose other than this study and your responses to the survey will remain anonymous.

E-mail address ____

THANK YOU FOR COMPLETING THIS SURVEY.

Questions? Go online to www.wsdot.wa.gov/Projects/LkWaMgt/

sired from respondents. The remaining questions are useful for a variety of purposes including the travel demand model refinement.

The following sections provide a summary of the Travel Pattern Survey Results.

TIME PERIOD OF TRIP

The first question on the survey asked respondents the timing of the recent trip they describe in later questions. Respondents were requested to check one of five time periods. The pie-chart on the left in Figure 2-18 illustrates the actual survey responses. The pie-chart on the right shows the distribution of traffic by time period based on traffic counts. The two pie charts show that the AM and PM peak respondents were over-represented relative to the traffic volumes on the SR 520 bridge. Whenever the daily survey results were used, a factoring process was applied to account for this over-representation by time period.

TRIP PURPOSE

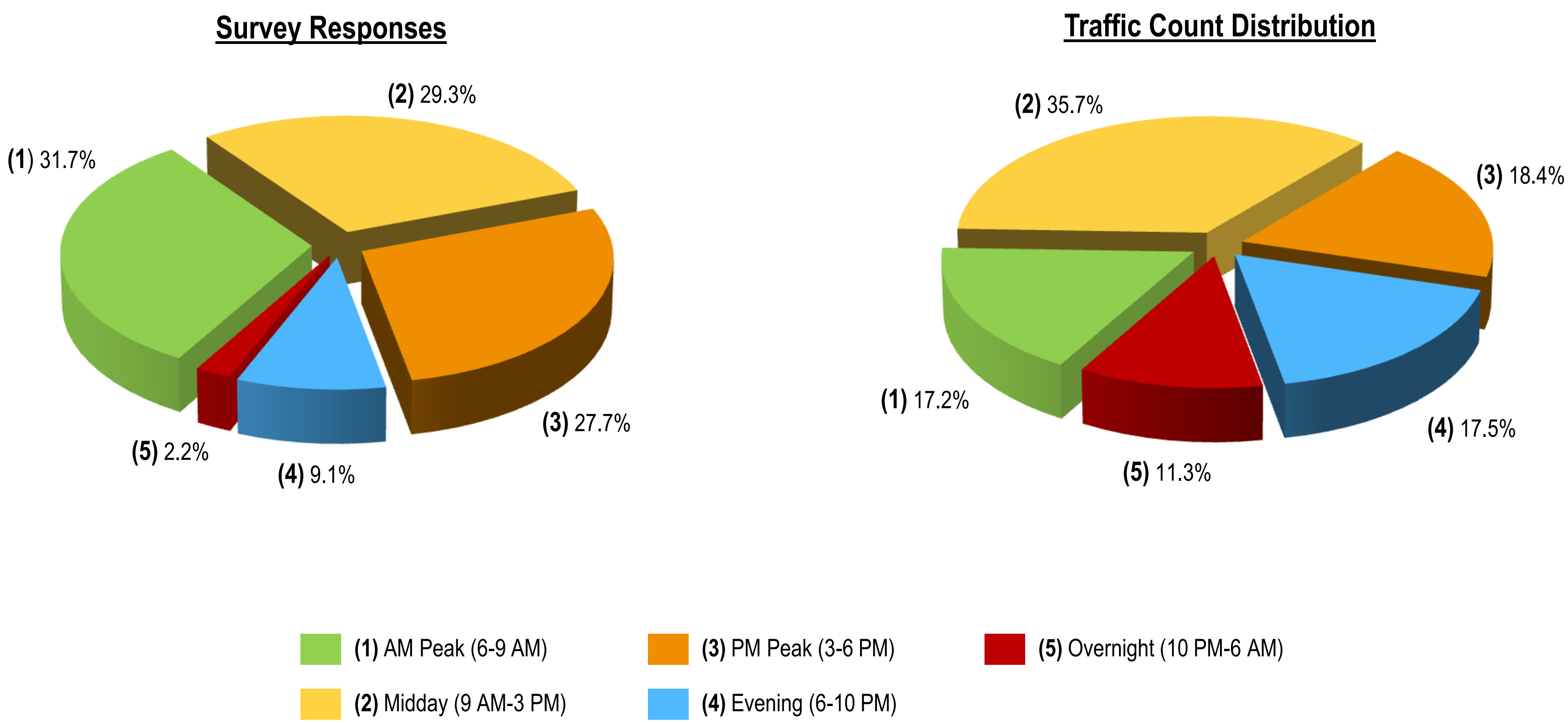
Commuter trips to and from work accounted for 60 percent of all trip purposes. However, the trip purposes varied widely by time period. Figure 2-19 shows the percentage of respondents within each trip purpose by time period. Figure 2-19 shows that the commuter trips were, not surprisingly, concentrated in the AM and PM peak periods. During the AM peak, 85 percent of respondents were commuting to work.

FREQUENCY

Figure 2-20 shows the trip frequency for each travel time period. Trip frequency responses were heavily concentrated in the “less than one time per week” and “five times per week” categories. Among all time periods, these two categories accounted for approximately 56 percent of responses. However, there is a sharp dichotomy between the peak and off-peak periods. During the AM and PM peak periods (when most drivers are traveling to or from work), the percentage of frequent travelers (“5 times per week”) is very high (59 and 41 percent). During the two off-peak periods, the percentage of “Less than one” respondents is highest (ranging from 33 to 38 percent). From the data, WSA calculated the average trip frequency within each time period. The highest average trip frequency is 4.13 and occurs during the AM peak; the lowest average trip frequency is 1.85 during the midday time period.

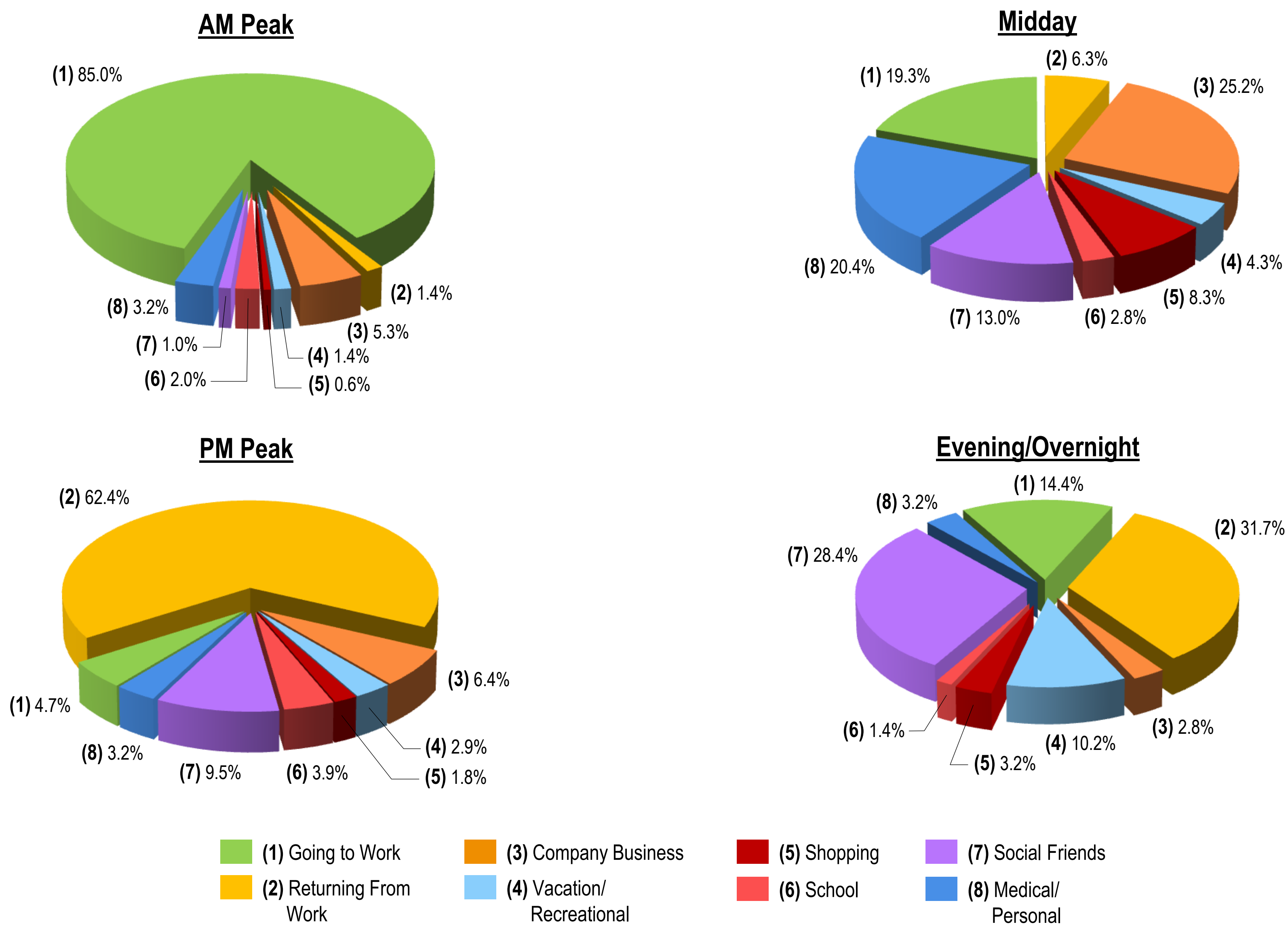
VEHICLE CLASS

Depending on the time period, between 94 and 98 percent of survey respondents drove passenger cars, with an average of 96 percent. Only 1.6 percent of the respondents were truck drivers (with a range of 1.1 to 2.0



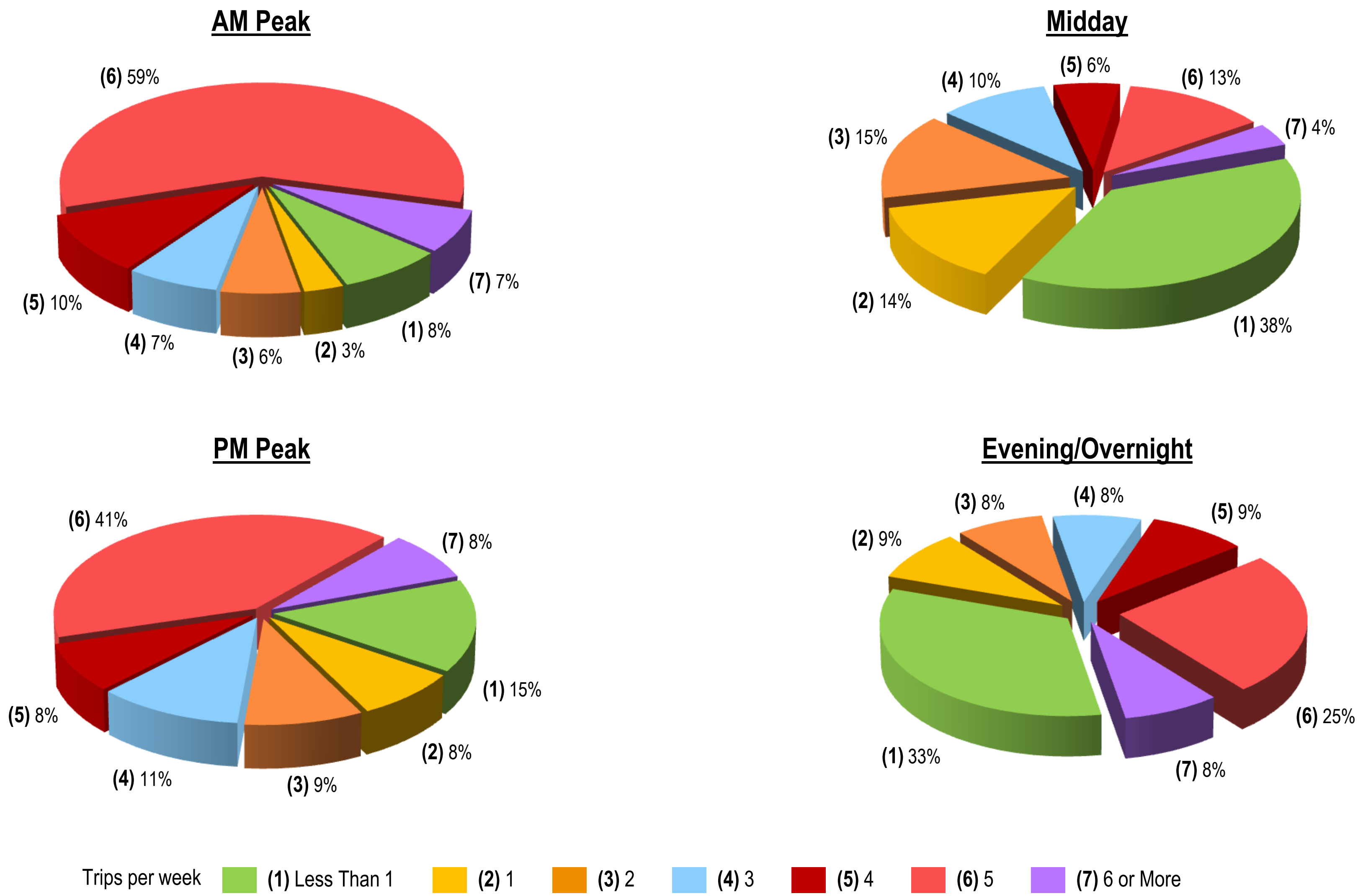
RESPONDENTS' TRAVEL TIME PERIOD

FIGURE 2-18



TRIP PURPOSE BY TIME PERIOD

FIGURE 2-19



TRIP FREQUENCY BY TIME PERIOD

FIGURE 2-20

percent depending on the time period). The third vehicle category was all other vehicles that were not a car or truck. Based on a cross-tabulation query of vehicle occupancy by vehicle type, more than 90 percent of these “other vehicles” had vehicle occupancy of “six or more persons.” Thus it appears that nearly all of the “other” vehicles were private buses or vanpools. Overall, the category accounted for 2.6 percent of respondents, but during the two peak periods the percentage increased sharply to four percent, which is consistent with vanpool and private buses operations in the bridge area.

TRIP ORIGINS AND DESTINATIONS

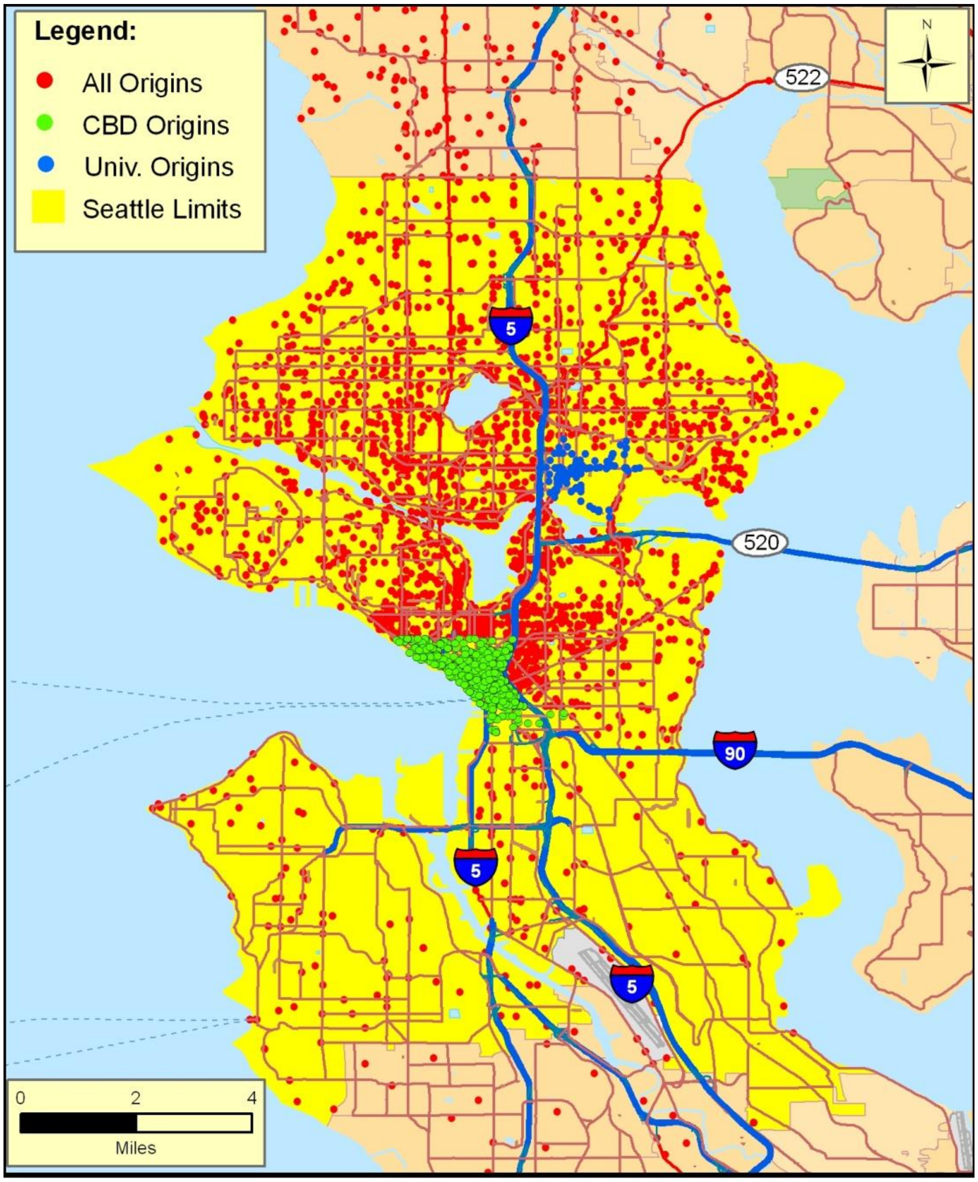
The trip origin and destination provide an important input to the analysis of usage of the road under tolling scenarios. The relative location of origin and destination to the bridge impacts the probability of alternative routes being used under tolling. Drivers were asked to provide information regarding an eastbound trip only. Therefore it is not surprising that 93 percent of trips originated from with the city of Seattle. Shoreline and Edmonds were the only other origin cities that constituted more than one percent of survey trips. Figure 2-21 shows the distribution of origins within the city of Seattle. Central Business District origins are about 17 percent of total origins and University of Washington area origins are about seven percent.

The trip destinations were distributed among a larger number of cities. However, the three most common destination cities accounted for just over 75 percent of survey trip destinations, they were: Bellevue (34 percent), Redmond (24 percent), and Kirkland (18 percent).

A summary of destination cities of eastbound trips on the SR 520 bridge is provided in Table 2-12 and is graphically depicted in Figure 2-22.

Table 2-12
Destination Cities of Surveyed Trips on SR 520 Bridge

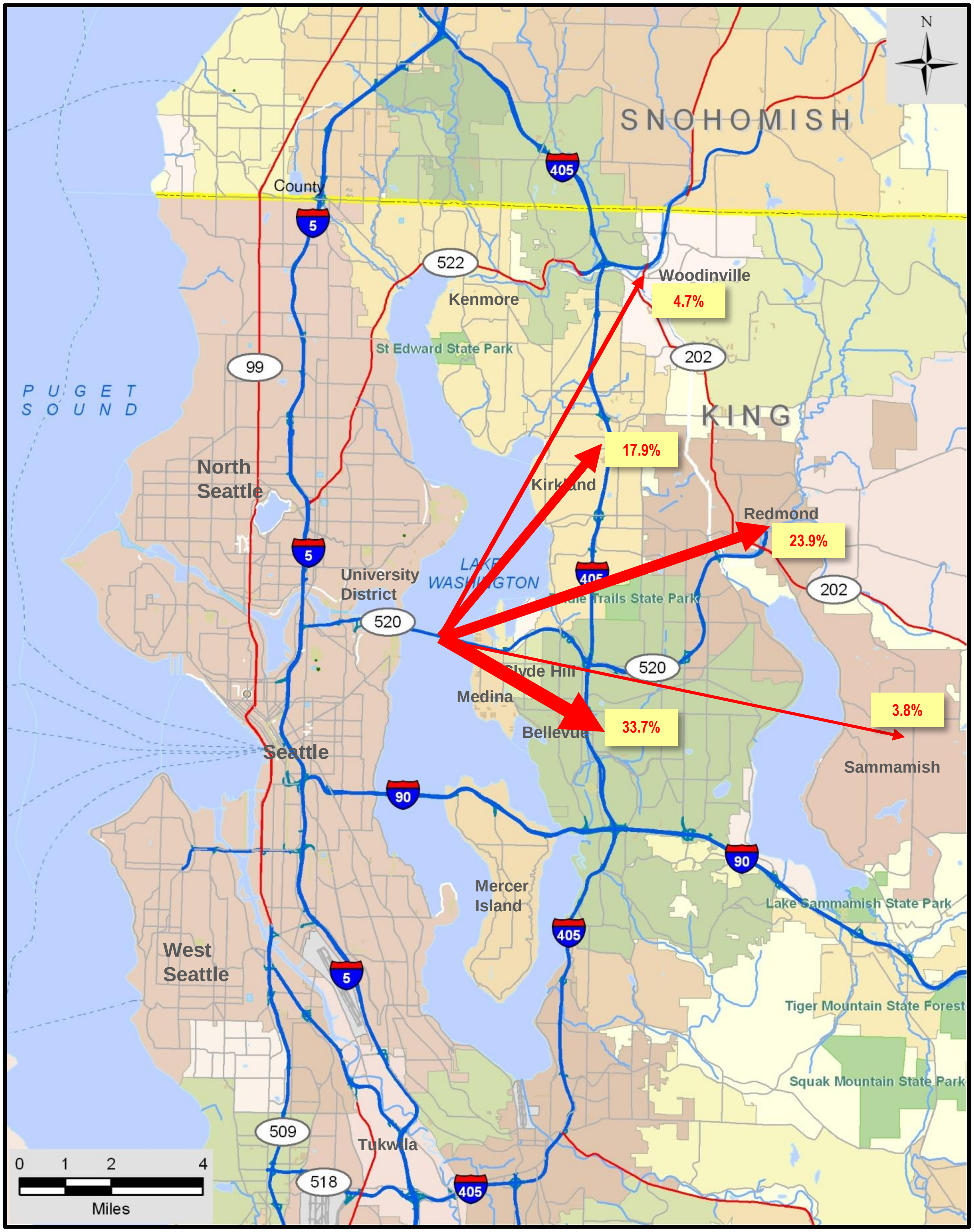
Destination City	Percent of Surveyed Trips
Bellevue	33.7%
Redmond	23.9%
Kirkland	17.9%
Woodinville	4.7%
Sammamish	3.8%
Bothell	2.1%
Medina	2.0%
Clyde Hill	1.7%
Issaquah	1.1%
Snohomish	1.1%
Others	8.0%



Note: Seattle CBD and University limits obtained from PSRC

ORIGINS OF EASTBOUND TRIPS ON SR 520 BRIDGE

FIGURE 2-21



WilburSmith ASSOCIATES

DESTINATIONS OF EASTBOUND TRIPS ON SR 520 BRIDGE

FIGURE 2-22

CHAPTER 3

STATED PREFERENCE SURVEY

In order to help estimate the response of existing State Route 520 (SR 520) bridge users to tolling, a special survey technique (called a stated preference survey) was used to understand their sensitivities and how they trade off time, cost, convenience, etc. Stated preference surveys provide the ability to estimate demand models for the facility that can be used to predict how travelers are likely to utilize the facility under different pricing and congestion scenarios, which is difficult to assess through conventional survey techniques or existing travel patterns alone. The stated preference survey presented hypothetical scenarios within the context of the respondent's actual travel, and asked respondents to choose from a set of possible options. Wilbur Smith Associates (WSA) teamed with Resource Systems Group (RSG) to design the survey, administer it to current bridge users, and evaluate the results. The stated preference survey was conducted in November 2009.

A primary objective of the stated preference survey was to provide information to develop an assessment of current bridge users' willingness to pay tolls. The survey also provided a basis to estimate changes in travel behavior that would:

- Result in less trip making, such as forgoing trips or choosing a different destination
- Result in changing to alternative modes including transit
- Result in shifting time of travel

The survey was designed to provide sufficient detail to allow follow-on analyses of traveler responses to different toll structures and to allow analysis of toll sensitivities by travel mode and trip type sufficient to support modeling of route diversion, mode shifts, and changes in the time of travel.

SURVEY APPROACH

The stated preference survey questionnaire was developed and implemented to gather information from automobile travelers who currently use the SR 520 bridge. The questionnaire collected data on current travel behaviors, presented respondents with information about bridge improvements, and used stated preference experiments to collect data that were used to estimate travelers' value of time (VOT) and propensity to use the tolled facility.

The survey instrument was a computer-assisted self-interview developed using RSG's proprietary software. The customized survey software adapted to respondents' previous answers by modifying question wording and stated preference tradeoff values. These features allowed presentation of future conditions that made the conditions realistic for the survey participant while allowing aggregation of the results for analysis. Electronic validation of each question eliminated item non-response and prevented the entry of invalid inputs.

Participants were selected from a sub-set of participants in the travel pattern origin-destination survey conducted prior to the stated preference survey. They were invited and preliminarily screened via e-mail. Steps were taken to assure the range of SR 520 users included in the survey appropriately represent the overall SR 520 user market.

SURVEY QUESTIONNAIRE

The questionnaire contained questions grouped into four main sections:

- Screening and revealed preference questions
- Stated preference questions
- Debriefing and opinion questions
- Demographic questions

SCREENING AND REVEALED PREFERENCE QUESTIONS

Initially, survey candidates were asked several questions, including if they had made a recent trip on the SR 520 bridge to determine if they were eligible to participate in the survey. Those who were eligible were then asked questions related to a recent one-way trip across the bridge. They were asked to think of this trip as their "reference trip." These "revealed preference" questions provided the respondents actual behavior related to particular topics. The questions included:

- Day of the week of the trip
- Trip purpose
- Trip origin and destination
- Trip frequency
- Trip start time, travel time, and delay
- Vehicle occupancy
- Flexibility in trip departure time
- Frequency of transit use
- Next best alternative route to SR 520 (limited to appropriate combinations of I-90, SR 522, I-5, and I-405)

The origin and destination questions used on-screen maps and address location features to determine if the participant's origin and destination would reasonably match a trip on the SR 520 bridge. Those with invalid responses were asked to correct their information or use a different trip on the SR 520 bridge as their reference trip. Participants who indicated unusually long or short travel times compared to their stated origin and destination were asked to confirm or correct their travel time.

Follow-up questions were based on answers to the initial questions, including:

- Requesting additional details on airport trips
- Whether passengers were residents in the same household
- For off-peak travelers, whether the trip was made at this time in response to traffic congestion and if so, would their trip have been made at a different time if there was no traffic congestion
- For those experiencing congestion, obtaining an estimate of the travel time without congestion, if known

STATED PREFERENCE QUESTIONS

At the beginning of the stated preference questions, participants were provided information on the SR 520 project and explanations of proposed payment options including electronic transponders linked to pre-paid accounts and license plate tolls payable via invoices mailed to the registered owner.

Stated preference questions ask respondents what they are most likely to do given a certain set of circumstances. The stated preference section of the questionnaire contained quantitative experiments to estimate respondents' preferences for travel under hypothetical scenarios. Each respondent was presented with eight trade-off scenarios. In each scenario, the respondent was asked to select from up to five possible travel options once tolling begins on SR 520. Each option generally included total travel time, cost, and mode. The specific alternatives presented to each respondent depended on the details of their reference trip. All respondents were presented the following three alternatives:

1. Use SR 520 by driving at current departure time
2. Use alternate route by driving at current departure time
3. Take a bus across SR 520 at current departure time

Respondents who reported a trip with fewer than three vehicle occupants (Single Occupancy Vehicle (SOV) or high occupancy vehicle with two occupancy requirement (HOV2)) were shown a fourth alternative:

4. Use SR 520 by driving at current departure time with additional passenger(s)

Respondents who reported a trip with a peak period departure time (6:00 am to 10:00 am or 3:00 pm to 7:00 pm) were shown a fifth alternative:

5. Use SR 520 by driving, departing before or after the specified peak period

As noted above, the alternatives included the travel time and travel cost. For respondents with a reference trip in the peak period, the alternatives included the time of departure. Transit alternatives were also presented.

Figure 3-1 presents a sample stated preference scenario for a peak-period reference trip with fewer than two passengers (SOV or HOV2). An explanation of the options follows.

In Figure 3-1, the respondent is asked to choose between five options which are alternatives to their toll-free reference trip:

1. Travel alone in their vehicle during the peak period and paying a toll of $3.00
2. Travel alone in their vehicle outside of the peak period and paying a lower toll of $2.70 with a lower total trip time
3. Carpool with another person which adds eight minutes of travel time (to pick up the passenger), travel during the peak period, and not paying a toll (carpool was also tested with toll in another question)
4. Traveling alone in their vehicle using SR 522 as an alternative route during the peak period but taking significantly more time and not paying a toll

Below are 5 different travel options for your one-way weekday trip with no passengers. These options include information on travel time, travel cost, time of day and the number of passengers in your vehicle.

If these options were the only options available for your one-way trip, which would you choose? Select an option by clicking a button below.

○ Drive on SR 520 during the peak	○ Drive on SR 520 before or after the peak	○ Drive on SR 520 with 1 additional passenger	○ Drive on your next best route: SR 522	○ Use express bus service on SR 520
Travel between 6:00 AM and 9:00 AM	Travel either before 6:00 AM or after 9:00 AM	Travel between 6:00 AM and 9:00 AM	Travel between 6:00 AM and 9:00 AM	Travel between 6:00 AM and 9:00 AM
Travel time: 32 mins.	Travel time: 28 mins.	Travel time: 40 mins.	Travel time: 52 mins.	Travel time: 40 mins.
Toll cost: $3.00	Toll cost: $2.70	Toll free	Toll free	Fare: $3.00

(Question 1 of 8)

Next Question

STATED PREFERENCE CHOICE EXPERIMENT SCREEN CAPTURE

FIGURE 3-1

5. Traveling via transit during the peak period with eight more minutes of travel time (due to accessing the transit vehicle and/or transit travel time difference) and paying a transit fare of $3.00

Respondents were asked to choose the alternative they would most prefer for making their trip in the future based on the scenarios presented, resulting in their "stated preference" (their actual preference or "revealed preference" will not be known until tolling begins on the bridge and the respondent makes their trip). In this way, respondents trade-off the various attributes, expressing their sensitivity to travel choices, time, and cost.

Over the course of the choice experiments, several distinct combinations were tested. The example above shows Options 1 and 5 having the same departure and cost, but transit would be a longer travel time. In other experiments, transit options had a shorter travel time than driving alone. The range of options is presented over many experiments and many respondents to infer the full range of VOT and travel preferences for bridge users.

The experimental design, which ensured information was collected in a statistically efficient manner, contained 64 such stated preference experiments divided into eight groups of eight. One group was selected for each participant and presented in random order.

Debrief and Opinion Questions

To further understand how respondents could change their travel in the future once the SR 520 bridge is tolled, follow-up questions were asked of participants based on stated preference responses. Participants were asked to indicate:

- If, given a certain travel time and toll cost, would they change the frequency of their reference trip and by how much
- If they would make fewer trips due to tolling, how much would they reduce their trips, and how would they achieve that (such as not making a trip or combining it with another trip across the SR 520 bridge)
- If the toll alternatives were never selected in a scenario, the primary reason they were not selected (such as opposition to paying tolls, toll cost too high, or time savings not great enough)
- If an alternative that included a change in the departure time was selected, whether they would leave earlier or later, as well as the primary reason for their choice (such as lower toll cost or lower travel time)

- If an alternative that included a change in departure time was not selected, the primary reason for their choice (such as not having time flexibility or insufficient cost savings)
- If transit was never selected, conditions that would make the participant take transit such as more frequent service or lower transit cost
- If the participant did not have a Good to Go! toll transponder and indicated a tolled option, likelihood of paying tolls – by transponder or via Pay-by-Mail, depending on cost of each as presented

Participants were also asked a series of questions about their opinion of the SR 520 project and attitude toward climate change, public transportation, potential biases toward paying tolls, using toll roads, and changing travel behavior.

DEMOGRAPHIC QUESTIONS

To conclude the survey, participants were asked several demographic questions to identify differences in responses among traveler segments, and to verify that the sample contained a diverse cross-section of the population using the SR 520 bridge. Demographic information collected included household size, vehicle ownership, gender, age, employment status, and 2008 pre-tax household income. Finally, respondents were given the opportunity to receive a $10 gift card for their participation and provide their comments about the survey or the proposed improvements.

SURVEY ADMINISTRATION

The survey data was collected in October and November 2009. Travelers who had made a weekday trip across the bridge in the two weeks prior to the survey in a personal vehicle were considered eligible. E-mail invitations were used to screen participants and provided them with unique passwords to the online survey system.

SURVEY RESULTS

Approximately 2,000 respondents completed the stated preference survey. Additional data checks and survey validation reduced the number of survey responses used for analysis to about 1,800. Respondents were grouped into four market segments by trip purpose for analysis. These included commute/business related trips and non-business trips, which were subdivided by peak and off-peak travel time periods.

It should be noted that the stated preference survey sample is not intended to be a comprehensive representation of the population across items such as trip purpose and frequency. Furthermore, the sampling technique used (respondents were recruited from volunteers from the travel pattern survey) could result in a bias. Consequently, several demographic questions were asked to identify differences in responses among traveler segments and to verify that the sample contained a diverse cross-section of the population that uses the SR 520 bridge to cross Lake Washington. Demographic information collected included household size, vehicle ownership, gender, age, employment status, and 2008 pre-tax household income. This information was used to ensure sufficient representation from each traveler segment was included, so as to form a firm basis for the results.

REVEALED PREFERENCE AND DEMOGRAPHIC RESULTS

The analysis indicated that on the west side of Lake Washington, the majority of respondents live between I-90 and the King County line on the north side of Shoreline, WA. Respondents on the east side of Lake Washington generally live west of the Snoqualmie River, north of I-90, and south of the King County/Snohomish County line, including sections of Woodinville in Snohomish County.

About 64 percent of the respondents reported trips that were work commutes while another 13 percent reported a business trip. The remaining 23 percent were non-business related trips. Of all trips, fewer than one percent were trips to SeaTac Airport.

Many respondents (43 percent) reported one-way eastbound trips across the bridge four to five times a week, indicating a commuting pattern. (A five day a week commuting pattern would be five one-way eastbound trips a week.) A very small proportion (six percent) used the bridge more than five times a week. About 24 percent used the bridge one to three times per week. The remaining 27 percent used the bridge once a week or less. Consequently, about half of the users are commute trips or similar, a quarter are frequent users, and a quarter are infrequent users.

Most people reported reference trips that began in the morning between 6:00 am and 10:00 am (60 percent). Others (20 percent) indicated midday trips, and few (14 percent) reported afternoon trips between 3:00 pm and 7:00 pm. Nighttime trips were just six percent of total reported trips. Off-peak trips were made about half of the time to avoid congestion. Of those, 76 percent would have preferred to begin their trip during the peak hours. When looking at the ability to shift the time of trips, about 58 percent could shift. Those who could travel later were about 62 percent and those who could travel earlier were about 56 percent.

The majority of trips, about 60 percent, took 21 to 40 minutes from origin to destination. About 26 percent took 41-60 minutes, and 14 percent were 20 minutes or less. Most people (60 percent) experienced delay during their trip, with 66 percent reporting 15 to 29 minutes of delay and 23 percent reporting 30 to 44 minutes of delay.

Almost 83 percent of respondents traveled alone, while 13 percent traveled in two-person carpools and four percent traveled with three or more people. However, actual traffic counts revealed about 11 percent of all cross-bridge traffic is in two-person carpools and about one percent is in three-person or more carpools and vanpools. Of the people traveling with others, 62 percent reported one of their passengers being from their household.

The preferred alternative routes to the SR 520 bridge were the I-90 bridge (72 percent) and SR 522 (20 percent), while eight percent would choose other routes such as I-5 and I-405.

About three-quarters of the respondents would not change their frequency of trips under tolling. Those that would reduce their trips would do so by changing destinations (46 percent) or no longer making the trip at all (45 percent). Less than 10 percent would combine their trip with other trips they already make across Lake Washington.

Some respondents indicated they use public transit. About 11 percent use it once a week or more, 11 percent use it a couple times a month, 32 percent use it less than once per month, and 46 percent never use it.

Only about two percent of respondents had a Good-To-Go! toll transponder but 85 percent of those who would choose a tolled option would likely get a transponder. The majority of those who would not get a transponder cited the infrequency of their trips as the reason.

Stated Preference Results

The stated preference section of the survey was used to ascertain responses to different travel scenarios. In each stated preference scenario, respondents were presented three to five alternatives for making a future trip. A series of eight stated preference scenarios were presented to each respondent.

After compiling this information over all respondents, a dataset of over 14,000 observations was available for further analysis. This process included screening to make sure trips included in the results were realistic trips. Trips with very long travel times or very short travel distances were excluded. Also, respondents whose answers to open-ended questions suggested carelessness or inattention, as well as respondents with very short survey completion times, were excluded from the analysis.

The resulting observations were used to develop a multinomial logit mode choice model. This type of statistical model is used very frequently in the transportation industry to forecast traveler responses to trip parameters. The statistical estimation and specification testing of the mode choice model was completed using a maximum likelihood procedure that estimated a single set of model coefficients. The model was then used to estimate:

- VOT specific to the SR 520 users
- Motorist response to tolls on SR 520 bridge in terms of possible shifts to transit, alternative routes, or to time periods with lower tolls

The statistical model provided input into the Tolling Analysis Model.

VALUE OF TIME

The VOT distribution used for the Tolling Analysis Model is presented in Table 3-1. The derivation of these values involved analysis of the stated preference survey results, demographic data, comparison to other such measures, and application of common practices in this field. This section provides additional discussion and summary on these topics.

The 2009 stated preference survey results were compared to a similar stated preference survey of SR 520 users in 2003. The comparison results are shown in Table 3-2.

Table 3-1
VOT used in the SR 520 Study (2010$)

Category	VOT $/Min.	VOT $/Hr.
HBW SOV Income Group 1	$ 0.16	$ 9.60
HBW SOV Income Group 2	$ 0.23	$ 13.80
HBW SOV Income Group 3	$ 0.28	$ 16.80
HBW SOV Income Group 4	$ 0.38	$ 22.80
Non-work SOV	$ 0.23	$ 13.80
HOV2	$ 0.40	$ 24.00
HOV3+	$ 0.45	$ 27.00
Light Truck	$ 0.50	$ 30.00
Medium Truck	$ 0.50	$ 30.00
Heavy Truck	$ 0.60	$ 36.00

All values in 2010 dollars
Home-based Work Single Occupant Vehicle (HBW SOV) Income Groups:
Household Income Group 1: <$32,000/yr
Household Income Group 2: $32,00-58,000/yr
Household Income Group 3: $58,000-96,000/yr
Household Income Group 4: >$96,000/yr
NW SOV = Non-w ork Single Occupant Vehicle
HOV2 = High-occupancy vahicle, 2 occupants
HOV3+ = High-occupancy vahicle, 3 or more occupants

Table 3-2
Comparison of 2003 and 2009 Stated Preference Survey Value of Time

Type of Trip	2003 Stated Preference Survey VOT	2009 Stated Preference Survey VOT	% Difference
Peak Work	$ 15.11	$ 10.72	-29%
Peak Non Work	$ 7.94	$ 7.60	-4%
Off Peak Work	$ 12.17	$ 10.62	-13%
Off Peak Non Work	$ 13.98	$ 11.61	-17%
Aggregate	$ 13.71	$ 10.40	-24%

Note: All values in 2010 dollars per hour

As is shown in the table above, the VOTs derived from the 2009 stated preference survey were demonstrably lower than those estimated from the 2003 survey. Data from the Volpe Center's *Travel Behavior Panel Study* for the SR 520 corridor[1] indicate that the median annual household income for this corridor is just over $100,000, much higher than the regional median income of $64,300 for 2009. (The median income of respondents for the 2009 stated preference survey was approximately $125,000.) While the range of the values from the 2009 survey falls within the average range for the region estimated from other sources[2], the higher incomes of travelers in this corridor suggests that the VOTs should be higher than the regional average but were not reported as such from this survey for the reasons discussed below.

In comparison, a 2007 study of travelers in New York City's Lincoln Tunnel corridor, in which the median incomes were also approximately $100,000, found VOTs ranging from $9 to $21/hour for commuters and $6 to $12/hour for other trip purposes (all values in 2007 dollars). For commuters who used electronic toll collection/transponder payment system in the peak periods, VOTs at the median income ranged from $15 to $21/hour.[3] The latter range is approximately 40 to 55 percent of the wage rate at this income level.[4] This is well within the range of 20 percent to 100 percent of income suggested in the literature[5] and the 20 percent to 80 percent of income that RSG has found in its past studies.

The comparisons made above suggest that the VOTs estimated from the 2009 SR 520 stated preference survey are lower than would have been ex-

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[1] Greene, E., S. Peirce and M. Petrella, "Evaluating the Impact of Road Pricing on Traveler Behavior in the Seattle Region Using Household Travel Diary Surveys," presented at 13th TRB National Transportation Planning Applications Conference, May 2011. The survey sampling for this Volpe Center study was designed to be representative of the corridor traveling population along all dimensions. The sampling that was conducted for the stated preference surveys was designed to collect accurate information about traveler behavior for all of the key traveler segments but was not designed to be strictly population proportional with respect to demographics such as income. However, for forecasting, the resulting models are applied to the appropriate population proportions by income.

[2] The draft final report for SHRP-2 C-04, *Improving Our Understanding of How Highway Congestion and Pricing Affect Travel Demand* (2011) reports values of $7-$12/hour from analysis of the Seattle Travel Choices data and $11-$12/hour from stated preference route choice data collected as part of the most recent PSRC household travel survey.

[3] Resource Systems Group, Inc. *Lincoln Tunnel Hot Lane Stated Preference Travel Survey*, final report prepared for Port Authority of New York and New Jersey, February 2008.

[4] Calculated as annual household income divided by 2,600 annual work hours (accounting for multiple workers/household).

[5] Small, Kenneth, "Urban Transportation Economics," *Vol. 51 of Fundamental of Pure and Applied Economics*, Chur, Switzerland, Harwood Academic Publishers, 1992.

pected. There is one obvious reason for this – the 2009 survey was conducted during a major economic recession. While the Puget Sound region was not as significantly impacted by the recession as other regions of the U.S., consumers in the region experienced similar uncertainty about the economy. This likely translated into a more conservative approach to discretionary spending, including significant reductions in utility and services spending, as was observed throughout the country during this period.

Stated preference surveys conducted by RSG in other regions during this period generally found lower VOTs than those conducted before the recession. A 2009 study for the Monroe Connector in the Charlotte, North Carolina metropolitan region indicated VOTs ranging from $7 to $7.50/hour for a corridor with a median income of about $70,000. These values are lower than those found in a 2007 study for a project in the Raleigh-Durham region where the VOTs were found to be approximately $10/hour for a similar income level. While some of the difference could be attributed to regional variations, it is also likely that much of the difference was due to the change in economic conditions and outlook.

Another comparison was made of the 2009 stated preference survey VOTs to those currently being used in the Puget Sound Regional Council's (PSRC) regional model. The aggregate VOT for peak work trips is shown along with the 2003 stated preference survey results in Table 3-3.

Table 3-3
Comparison of Aggregate Peak Work Value of Time
Stated Preference Surveys and PSRC Model

Category	VOT
2003 Stated Preference Survey	$ 15.11
2009 Stated Preference Survey	$ 10.72
PSRC Model	$ 28.63

Note: All values in 2010 dollars per hour

The PSRC approach to estimating VOT was based on a limited sample (275 households) but long duration (12 month) user cost study. Volunteer participants were provided an appropriate amount of "toll funds" to cover their regular travel in an account linked to a Global Positioning System (GPS). They were provided route and time of day based "toll charges."

Drivers were free to select their time and route of travel. Participants retained any funds left over after accounting for the "toll charges." PSRC used data from this experimental study to estimate VOTs for the current PSRC model. This experiment differed significantly from traditional toll impact study methodology and the PSRC analysis resulted in very high VOTs when compared to area wage rates. For example, using the $100,000 corridor median income estimate and 2,600 hours per household worked per year, the average hourly wage would be approximately $38.46. The PSRC VOT is almost 75 percent of this wage rate, which falls close to the upper limit of the generally accepted range (20-80 percent) used for calculating VOTs based on wage rates.

The comparisons provided above suggest that an accurate estimate of the VOTs for this corridor would be higher than obtained in the 2009 SR 520 stated preference survey, about the same as the 2003 SR 520 stated preference survey, and lower than the PSRC model. Consequently, an approach was developed to adjust VOT results from the 2009 survey for use in this study. This was based on the following considerations:

- Using income data and established relationships, develop a reasonable minimum level of VOT for the high (and largest) income group
- Maintain the proportions of various market segments of income and vehicle occupancy from the stated preference survey
- Utilize an aggregate approach to re-benchmark the VOT

The primary data inputs to the adjustment process were the Census 2000 variables for the persons in households and the number of hours that they worked. These were assembled for the bridge influence area including Seattle, Redmond, and Bellevue. The 2000 U.S. Census was used to obtain the total hours worked (similar data from the 2010 Census is not yet available) and Consumer Price Index (CPI) data from Bureau of Labor Statistics (BLS) was used for conversions between 2009 and Census year data. All data was specific to the study region.

The underlying assumption in this approach is that a reasonable average VOT can be estimated from the median income and the total hours worked in a household. The computation involved using the Census data for the number of hours worked in the influence area and the total number of households to determine the average hours worked per year per household. An annual household income of $125,000 (median household income from the 2009 stated preference survey) was considered to represent the highest income group for VOT purposes. This income level was converted to 1999 dollars for use with the Census data, and an average hourly income was calculated based on this income level and the household work statistics.

The average hourly income was then adjusted based on trip purpose. Research has shown that VOT varies by trip purpose, with certain trips, such as work related, having a higher VOT than commuting and discretionary trips. Using the distribution of trips by purpose from the PSRC trip generation data, the hourly income was adjusted for each purpose using a "Perception Weighting" of 30 percent to 60 percent which was applied to reflect the relative importance of each trip purpose. An adjusted cumulative VOT was thus determined in terms of 1999 dollars which was then converted to 2010 dollars using CPI data. The VOT calculated was assigned to SOV Income Group 4.

The information from the stated preference survey was then used to calculate the proportional VOT for other SOV groups. The original relationship between SOVs and high occupancy vehicles (HOVs) was used to calculate the VOT for HOV2 and high occupancy vehicle with a 3+ occupancy requirement (HOV3+). In the absence of additional information for trucks, the year 2000 VOT for trucks from the PSRC model was converted to 2010 dollars and then slightly adjusted for calibration purposes. Final VOT values used for the SR 520 tolling analysis are summarized in Table 3-1 as noted at the beginning of this section. The VOT values are higher than the 2009 stated preference survey results and the 2003 similar results, yet lower than the PSRC VOT. A direct comparison of the aggregate peak work trip VOT from each of the SR 520 surveys, the PSRC model, and the VOT used for the SR 520 Tolling Analysis Model is provided in Table 3-4.

Table 3-4
Comparison of Aggregate Peak Work Value of Time
Stated Preference Surveys, PSRC Model, and SR 520 Tolling Analysis Model

Category	VOT	
2009 Stated Preference Survey	$	10.72
2003 Stated Preference Survey	$	15.11
SR 520 Tolling Analysis Model	$	17.70
PSRC Model	$	28.63

Note: All values in 2010 dollars per hour

TRIP SUPPRESSION, SHIFTS TO TRANSIT, AND CHANGES IN TRIP TIMING

The stated preference survey provided additional information about motorists' tendency to change their trip making frequency on SR 520, shift to transit, or change the departure time of their trip to lower toll periods under tolling. These effects result in fewer trips being made on the bridge, trips made by private vehicles shifting to transit, and trips made at different times to avoid peak period tolls, respectively. Trip suppression and shifts to transit were both implemented as functions inside the Tolling Analysis Model while changes in trip timing were implemented through model post-processing.

Trip Suppression

Trip suppression included three sources of suppression: trips combined with other trips already made across Lake Washington, trips to a different destination to avoid crossing Lake Washington, and trips no longer made. The stated preference survey results showed trip combination will likely account for about 9 percent of the total effect, destination change for about 46 percent, and trip cancellation for about 45 percent, as shown in Table 3-5.

A trip suppression statistical model was developed as part of the stated preference survey analysis, derived from the participants' responses. The suppression model takes into account toll rates and travel time on the SR 520 bridge. The suppression statistical model calculates suppression for each origin/destination pair.

Table 3-5
Distribution of Suppressed Trips

Suppression Type	Distribution of Suppressed Trips
Trips Combined	9.0%
Destination Changed	45.9%
Trips Cancelled	45.1%
TOTAL	**100.0%**

The trip suppression model initially estimates the reduction in the number of SOV trips as a proportion of total trips. Current HOV trips across the bridge are likely made for specific purposes including commuting; thus, the likelihood of those trips being suppressed is lower. Consequently, for

HOV trips with two occupants, the suppression rate was assumed to be half the SOV suppression rate, and for HOV trips with three occupants, the suppression rate was assumed to be one-third of the SOV suppression rate.

Shifts to Transit

A set of utility functions was statistically estimated from the stated preference survey results which included pertinent variables related to shifts between travel modes including travel time and costs by mode, and vehicle occupancy. Economic consumer theory defines a "utility function" as a single objective function representing the attractiveness of an alternative in terms of its attributes. Economic theory assumes consumers will make their choice based on maximizing their utility. The concept is often used to model consumer behavior. The resulting utility functions gave the relative usefulness of:

- Using the same route at the same travel time
- Using the same route at alternative times
- Traveling at the same time and route but forming a carpool (HOV3+)
- Traveling an alternative route at same time
- Traveling on transit

The PSRC base model used for this study was a toll-free model. Consequently, the mode share results from the calibrated model run are reflective of non-tolled circumstances. When tolls are implemented, additional travelers are expected to shift to transit. However, when tolls are applied, the set of utility functions suggested that the shift from automobile to bus modes is affected not only by the transit travel time and cost but also by other factors such as automobile travel time, automobile travel cost, amount of time to shift trip before or after peak period, and vehicle occupancy.

To better understand the magnitude of impacts of those elements on shift to transit, numerous scenarios involving possible combinations of the input parameters were tested. These scenarios included automobile travel time to use SR 520 during peak hours, automobile travel time to use SR 520 before and after peak hours, automobile travel time to use alternate route during peak hours, toll costs, time involved to shift travel earlier or later, auto occupancy, transit travel time, and transit travel cost. The results of these tests indicated that mode shifts to transit ranged from around one percent to five percent of daily traffic. Most of the cases fall into the range of two percent to four percent.

The total trip suppression combined with the shift to transit was capped at five percent on the basis of the analyses described above, but allowed to vary below this amount according to the estimated utility equations and each particular toll rate tested as applied in the tolling model. Consequently, over 95 percent of trips would not be suppressed or shift to transit by tolling levels tested for the SR 520 bridge. Additionally, a sensitivity test for higher and lower limits of total trip suppression combined with shifts to transit was performed, the results of which are discussed in Chapter 8.

Changes in Trip Timing

Using the same utility functions described in the prior section, adjustments to account for changes in trip timing were implemented in the post-toll model stages of the analysis. Avoidance of higher toll costs would have a tendency to flatten and spread travel demand during peak hours on the bridge. Up to 20 percent time shifting of trips away from peak periods and high toll rates was applied to the model output in the final traffic and revenue calculations.

CONCLUSIONS

The objectives of the stated preference survey analysis, as noted at the beginning of this chapter, were to:

- Assess current bridge users willingness to pay tolls and support diversion analysis
- Estimate changes in travel behavior that would result in less trip making such as forgoing trips or choosing a different destination, result in changing to alternative modes including transit, and/or result in shifting time of travel

As discussed in detail earlier in this chapter, the VOTs obtained from the 2009 stated preference survey were not used directly in the study. Instead, a set of VOTs was derived from the 2009 stated preference survey and Census data that was considered more appropriate for the facility being studied and the overall purpose of this study. Also, the stated preference survey results showed the relative propensity to change travel behavior as a result of several factors including VOT, ability to shift travel time, ability to forgo trips, and ability to change travel modes to transit or HOVs.

Consequently, the VOTs, mode shift, time shift, and trip suppression were formulated and applied to the toll estimation model, thus achieving the objectives of the stated preference survey analysis.

CHAPTER 4

ECONOMIC GROWTH REVIEW

INTRODUCTION

This Investment Grade Traffic and Revenue study will be used in support of project financing; therefore it is important to conduct an independent analysis of the expected economic growth of the region and to make appropriate assumptions for developing a finance plan. Economic growth is an important factor in evaluating the expected revenue from a toll facility. This review provides independently-developed socioeconomic forecasts of the parameters that were used in a travel demand model to project future travel in the region.

The independent economist for this study is Community Attributes Inc., (CAI) of Seattle. Community Attributes provides economic research and analysis to increase awareness, inform decisions, and improve results for a wide variety of clients. Data sources consulted for the economic study included state economic agency estimates and forecasts, metropolitan planning organization (Puget Sound Regional Council (PSRC)) estimates and forecasts, other private economists' forecasts, and national economic forecasts combined with other local data and State Route 520 (SR 520) specific travel shed information. While CAI is familiar with regional growth trends around the Seattle region, its staff has not been involved in the development of the outside forecasts used for this study. CAI consulted with PSRC to discuss data usage and application of the PSRC estimates and forecasts. However, PSRC did not participate in the estimating and forecasting process.

Generally, the Central Puget Sound Region is defined as including King, Snohomish, Pierce, and Kitsap Counties. The regional travel model covers this area. The travel shed for the SR 520 bridge is focused on King County where 95 percent of all bridge traffic has both an origin and destination. The major cities within the travel shed are Seattle, Bellevue, Redmond, and Kirkland, all of which are in King County.

REGIONAL DEVELOPMENT PATTERNS CONTEXT

A distinguishing feature of implementing tolls on the SR 520 bridge is the bridge's central location within the greater Seattle metropolitan area. The bridge lies between the region's two largest employment centers, Downtown Seattle and Downtown Bellevue. The highway extends eastward beyond Downtown Bellevue into Redmond. Redmond is another major employment center and is home to the Microsoft campus. These major employment centers have been established for many years and continue to grow, as described in this chapter.

Residential areas surrounding the SR 520 corridor have continuously been in high demand during the past several decades. The densest housing in the region exists at the western terminus of the bridge, which includes the University of Washington, Downtown Seattle, and several central Seattle neighborhoods. The same can be said of the eastern portions of SR 520 that connect to the bridge, which include the cities of Kirkland, Bellevue, and Redmond. These cities all have high density and highly valued homes.

Moreover, the culture and character vary considerably among the neighborhoods surrounding SR 520. As a result, for culture and lifestyle preferences, many people choose to live on the west side of the bridge and work on the east side, and vice versa. This can be seen in the balance of the peak directional flows on the SR 520 bridge (see Figure 2-9).

The historic density and continued vibrancy of the areas surrounding the bridge has resulted in steady demand for trips on SR 520 that far exceed the bridge's capacity. As shown in Figure 2-5, bridge traffic has remained constant in years past, in spite of the ups and downs of the regional economy that transpired during this same time. The demand for trips on the bridge is resilient to economic cycles, because of the bridge's central location and ongoing demand that exceeds the bridge's capacity.

This chapter presents analysis of the economic growth forecasted to continue in the major urban centers on both ends of the SR 520 corridor. Growth is not critical for the bridge to continue to be in high demand due to the area's density. In the long run, after tolling has begun, the growth forecast for the surrounding areas is expected to result in continued and increasing demand for trips across the bridge, as demonstrated in subsequent chapters.

METHODOLOGY

A general summary of the CAI work as well as other data are provided here. CAI provided initial socioeconomic forecasts in January 2010, much of which relied on estimates and forecasts through the third quarter of 2009. In fall 2010, CAI provided updated socioeconomic forecasts which accounted for another year of updated estimates, updated available data, and updated forecasts. This report reflects the updated information.

The CAI approach included reviewing current estimates and forecasts of socioeconomic measures for the overall region and employment sectors, and sub-regional differences in estimated population and employment growth. From this, a Baseline Scenario for regional growth was developed covering the Central Puget Sound Region. Utilizing this baseline information along with other adjustments, such as estimates of new building growth absorption, CAI developed detailed estimates and forecasts at a finer geographic scale. This finer geographic scale was compatible with the main regional travel demand model from PSRC, which was used as the basis for the tolling model developed for this study.

CAI developed population and employment estimates and forecasts for 2008, 2009, 2010, 2011, 2016, 2020, 2030, and 2040. CAI also developed number of household estimates and forecasts for the same geographic scope and years as part of their forecasting process. Population and employment growth forecasts were used as the basis for adjustments to long term travel demand growth as detailed further in Chapter 6.

While economic and travel activity has been on the increase in the greater Central Puget Sound Region, the area has not been immune to the recent recession. The current PSRC forecasts date from 2006. Therefore, the CAI analysis aimed at accounting for the recent recession and actual experience from 2006 through the beginning of 2010. The method combined existing regional and national resources, with primary data gathered expressly for this analysis, such as real-estate development pipeline and market data. The forecasts rely heavily on Conway Pedersen[1] forecasts published in September 2010, which cover the entire four-county region and include estimated recession impacts. Conway Pedersen reports are widely recognized to be one of the best forecasts of the regional situation in the greater Seattle area and have been so for many years. The resulting data by fore-

[1] Conway Pedersen Economics reports a probability of its forecasts, shown at 55 percent. Conway Pedersen Economics, Inc., does not guarantee the accuracy, adequacy, or completeness of any information or forecast, and is not responsible for any errors or omissions or the results obtained from the use of such information or forecast.

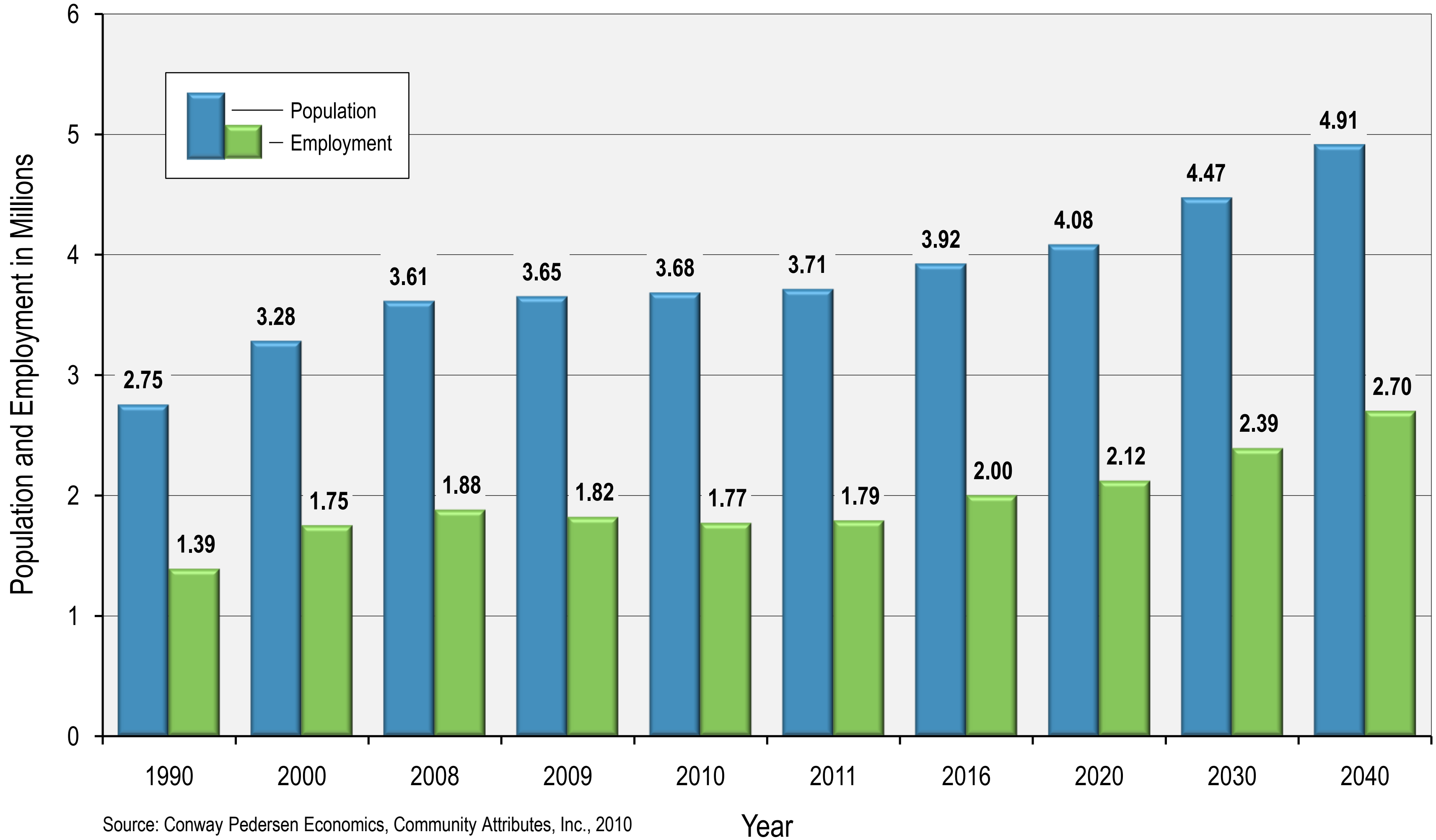
cast years are used as direct input to WSA's toll and traffic forecasting method.

REGIONAL LEVEL BASELINE SCENARIO

CAI developed a baseline population and employment forecast for the region. Baseline population in the Central Puget Sound Region is expected to grow steadily from an estimated 3.7 million people in 2010 to over 4.9 million by 2040, a compounded annual growth rate of 1.0 percent. Annual regional population growth is anticipated to be relatively steady beginning at 0.8 percent through 2011 then increasing to 1.1 percent through 2016 and decreasing slightly in the later forecast years. In comparison, population historically grew by 1.8 percent annually from 1990 to 2000 and 1.1 percent from 2000-2010. Figure 4-1 shows the population forecast.

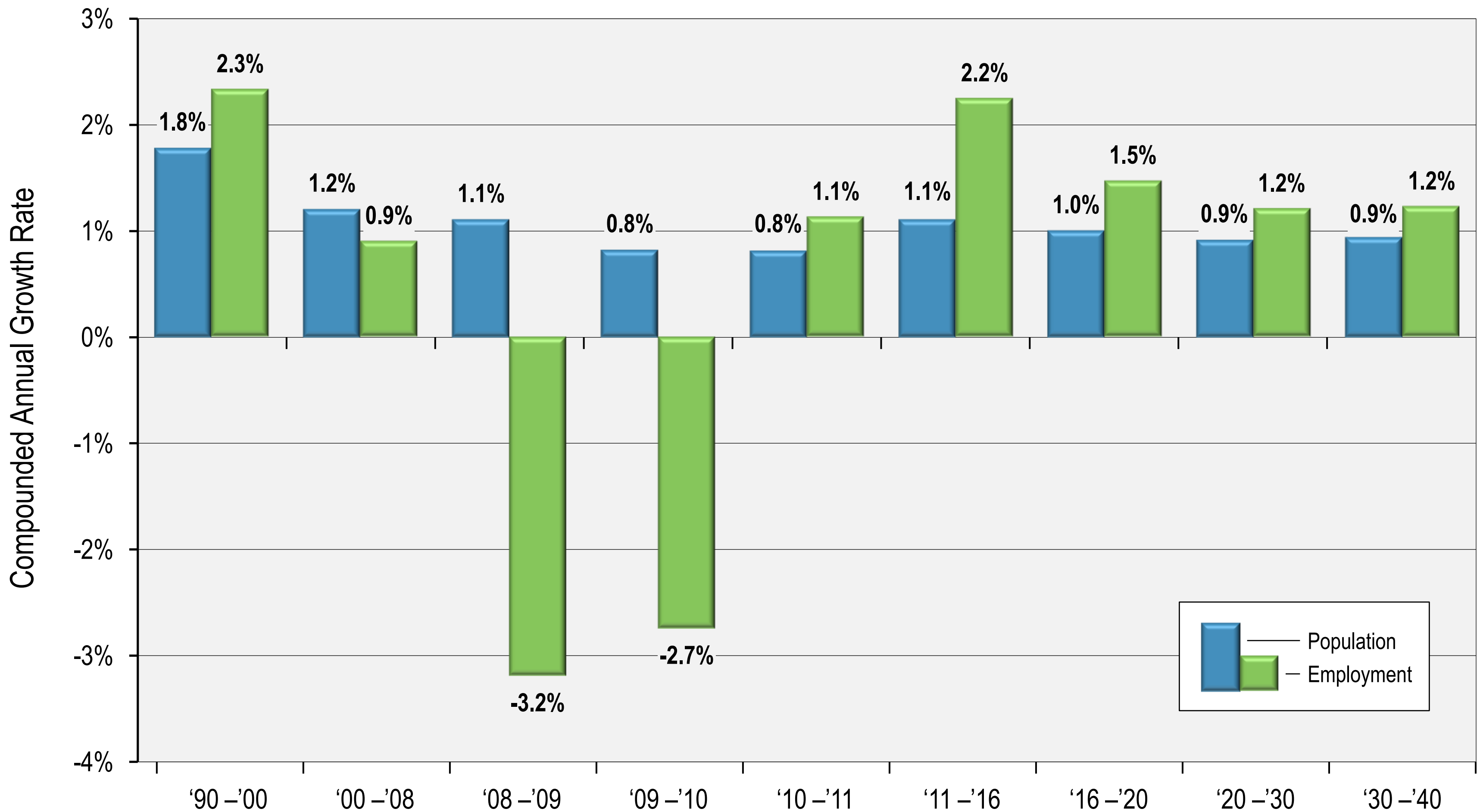
Regional employment is forecasted to decline through 2010, with job growth beginning in 2011. The region is expected to lose about 110,000 jobs from the 2008 peak to 2010, about a 5.9 percent loss during this period. After 2011, jobs are expected to increase for the rest of the time horizon, resulting in an overall increase in employment from approximately 1.8 million in 2010 to approximately 2.7 million in 2040, a 1.4 percent compounded annual increase. In comparison, employment grew by 2.3 percent annually from 1990 to 2000 and 0.0 percent from 2000 to 2010 due to the recession. Figure 4-1 shows the employment growth in relation to the population growth for the region. Figure 4-2 shows the corresponding average annual forecasted changes in the baseline population and employment of the region.

Table 4-1 shows the data in Figures 4-1 and 4-2 for 2009 to 2040 along with the total change and annual growth rate in the regional Baseline Scenario forecast. For most metropolitan regions, total population generally exceeds total employment. Consequently, increases in regional population are generally expected to exceed increases in regional employment. As can be seen in Table 4-1, the annual average growth in population is greater than the annual average growth in jobs for the forecast period, following expectations. However, employment appears to grow faster than population when one looks at the compound annual growth rate. Mathematically, the employment growth rate exceeds the population growth rate because there are fewer jobs in the region than people (about half as many); the basis for the employment growth rate calculation is smaller than the population basis, resulting in a larger percentage change for employment. Historically, this contrast between annual average growth and compound annual growth rate is true for most periods. In the Puget Sound Region from 1980 to 2010, the annual average growth in population has exceeded the annual average growth in employment each decade. During this same



Source: Conway Pedersen Economics, Community Attributes, Inc., 2010

REGIONAL POPULATION AND JOBS: CENTRAL PUGET SOUND REGION, 1990-2040, BASELINE SCENARIO



Source: Conway Pedersen Economics, Community Attributes, Inc., 2010

COMPOUNDED ANNUAL GROWTH RATES OF POPULATION AND JOBS: CENTRAL PUGET SOUND REGION, 1990-2040

FIGURE 4-2

period, the compound annual growth rate for employment exceeded the compound annual growth rate for population in each decade, except for 2000 to 2010 when the employment compound annual growth rate was zero, reflecting the steep decline in employment toward the end of the decade.

Table 4-1
Regional Population and Jobs, Central Puget Sound Region 2009-2040

Baseline Scenario	2009	2010	2011	2016	2020	2030	2040
Regional Total							
Jobs	1,816,700	1,770,000	1,794,700	1,996,500	2,115,500	2,393,200	2,700,100
Population	3,651,700	3,683,700	3,709,500	3,916,000	4,082,200	4,471,700	4,908,100

Change by Forecast Period	'09-'10	'10-'11	'11-'16	'16-'20	'20-'30	'30-'40
Annual Average Growth						
Jobs	-46,700	24,700	40,360	29,750	27,770	30,690
Population	32,000	25,800	41,300	41,550	38,950	43,640
Compound Annual Growth Rate (CAGR)						
Jobs	-2.57%	1.40%	2.15%	1.46%	1.24%	1.21%
Population	0.88%	0.70%	1.09%	1.04%	0.92%	0.94%

Source: Conway Pedersen Economics, Community Attributes, Inc., 2010

Table 4-2 shows the estimates and forecasts for jobs within specific industry sectors. The recession has affected FIRES (financial, insurance, real estate, and services), WTU (wholesale, trade, transportation, and utilities), and manufacturing employment the hardest from 2009 to 2010 including an over 6.0 percent decline in manufacturing employment. All sectors except government were forecasted to lose jobs in 2010. Increases in overall employment are expected to follow in 2011 and beyond. Modest recovery at 2.2 percent annually is expected from 2011 to 2016. FIRES sector employment is expected to have the largest sector increase in jobs in the area, eventually reaching a 3.2 percent annual increase from 2011 to 2016. Most other sectors show modest 1.4 percent to 2.1 percent growth through this same period, except for manufacturing which is expected to lose additional jobs at an annual rate of loss of 0.6 percent.

From 2016 to 2040, employment growth is expected to gradually decelerate, but overall employment change is expected to be positive throughout this period.

Table 4-2
Regional Employment Change by Sector, 2009-2011, 2016, 2020, 2030, 2040

Regional Jobs	2009	2010	2011	2016	2020	2030	2040
Employment Sector							
Retail	314,100	309,100	315,700	351,100	367,900	410,900	455,000
FIRES	794,100	770,900	789,500	923,200	1,006,800	1,202,400	1,413,800
Government	243,000	244,000	242,900	260,700	275,600	286,000	297,200
Eductation	123,300	121,300	120,700	129,500	136,900	144,000	152,200
WTU	147,700	142,200	143,700	155,500	159,000	179,300	203,000
Manufacturing	194,500	182,500	182,200	176,500	169,300	170,700	178,800
Total Jobs	1,816,700	1,770,000	1,794,700	1,996,500	2,115,500	2,393,300	2,700,000

Average Annual Change	'09-'10	'10-'11	'11-'16	'16-'20	'20-'30	'30-'40
Employment Sector						
Retail	-1.6%	2.1%	2.1%	1.2%	1.1%	1.0%
FIRES	-2.9%	2.4%	3.2%	2.2%	1.8%	1.6%
Government	0.4%	-0.5%	1.4%	1.4%	0.4%	0.4%
Eductation	-1.6%	-0.5%	1.4%	1.4%	0.5%	0.6%
WTU	-3.7%	1.1%	1.6%	0.6%	1.2%	1.2%
Manufacturing	-6.2%	-0.2%	-0.6%	-1.0%	0.1%	0.5%
Total Jobs	-2.6%	1.4%	2.2%	1.5%	1.2%	1.2%

FIRES is financial, insurance, real-estate, and services

WTU is wholesale, trade, transportation, and utilities

As shown in Table 4-3, growth within the Central Puget Sound Region is forecasted to vary among the cities and neighborhoods that make up the area. King County is expected to account for 40 percent of annual regional population growth during the 2010 to 2016 time period. While population growth in Seattle is forecasted to be 0.8 percent annually from 2010 to 2016, population growth in Bellevue is expected to be 1.4 percent annually during the same period. Overall, Seattle, Bellevue, Kirkland, and Redmond are expected to account for half the growth in King County population.

King County is expected to outpace regional employment growth over the near term (to 2016). The four key cities served by SR 520 are expected to account for 67 percent of annual job growth in King County from 2009 to 2016, and 44 percent of new jobs regionally.

Table 4-3
Near-term Population and Employment Forecasts
Areas of Interest 2008 - 2011, 2016

	2008	2009	2010	2011	2016	APC '10-'16
Population						
Seattle	589,500	598,400	608,100	614,500	637,700	0.8%
Bellevue	122,500	123,900	127,000	128,500	137,900	1.4%
Redmond	59,600	60,300	62,200	63,100	65,700	0.9%
Kirkland	49,000	49,600	50,100	50,600	52,300	0.7%
King County	1,872,000	1,895,700	1,919,600	1,935,700	2,012,200	0.8%
Four County Region	3,611,000	3,651,700	3,683,700	3,709,500	3,916,000	1.0%
	2008	**2009**	**2010**	**2011**	**2016**	**'10-'16**
Employment						
Seattle	520,300	495,400	481,500	489,700	538,900	1.9%
Bellevue	132,500	126,600	126,900	129,200	148,300	2.6%
Redmond	93,000	94,200	89,800	91,400	104,200	2.5%
Kirkland	32,600	30,900	29,700	30,800	36,100	3.3%
King County	1,220,000	1,173,800	1,140,100	1,158,700	1,289,200	2.1%
Four County Region	1,876,000	1,816,700	1,770,000	1,794,700	1,996,500	2.0%

APC is Average Annual Percentage Change

Other Socioeconomic Trends

Wilbur Smith Associates (WSA) also examined other key socioeconomic trends. Household median income trends were obtained from the American Community Survey of the U.S. Census Bureau. Table 4-4 shows Seattle and Bellevue household median incomes have increased on average 5.4 percent to 4.2 percent over the four years ending 2009 respectively. During this same time, King County income rose approximately 3.8 percent while the U.S. income as a whole only rose 2.1 percent. Also, the King County median income exceeds the Washington State median income by 18 percent to 21 percent and the U.S. median income by 26 percent to 35 percent over that time period. Seattle and Bellevue, two of the primary drivers of bridge traffic, exceed U.S. median income by 21 percent and 64 percent respectively in 2009. This information indicates the strong market and high income within the geographical area producing many SR 520 bridge trip origins and destinations.

Table 4-4
Household Median Income
2005-2009

	2005	2006	2007	2008	2009	APC '05-'09
Household Median Income						
Seattle	49,300	58,300	57,800	61,800	60,800	5.4%
Bellevue	69,900	76,800	78,700	80,000	82,400	4.2%
King County	58,400	63,500	67,000	70,200	67,800	3.8%
Seattle MSA	55,000	60,700	63,900	66,500	64,000	3.9%
Washington	49,300	52,600	55,600	58,100	56,500	3.5%
United States	46,200	48,500	50,700	52,000	50,200	2.1%

Source: U.S. Census Bureau, American Community Survey Website, Table S1903
APC is Average Annual Percentage Change

DEVELOPMENT OF SUB-REGIONAL LEVEL ESTIMATES AND FORECASTS

Next, it was necessary to develop sub-regional estimates and forecasts for socioeconomic growth so that the impact on the SR 520 bridge influence area could be determined. The PSRC regional travel demand model uses fine-scale geographic areas, known as Traffic Analysis Zones (TAZs), as a basis for its structure. A map of the zone system is shown in Figure 6-4. The sub-regional estimates and forecasts were developed to this TAZ zone structure.

The study area covered by the TAZ estimates and forecasts is the entirety of the four-county Central Puget Sound Region. Those areas with a greater influence on bridge traffic, based on the origin-destination survey conducted for this study and CAI and WSA local staff knowledge, were given detailed attention. These include the cities of Seattle, Shoreline, and Lake Forest Park on the west side of the bridge with a special emphasis on downtown Seattle. For the east side of the bridge, detailed areas include Bellevue, Kirkland, and Redmond.

CAI leveraged existing data sets to produce a custom sub-regional population and jobs forecasts for SR 520 travel areas. The CAI forecasts utilized the following data:

- The most recent current-year estimates of jobs and housing available for smaller geographies, including 2010 population estimates by census block groups from the Washington State Office of Financial Management, and jobs by TAZs from Washington State Employment Security, as produced and improved by PSRC
- Countywide estimates of employment, up to date to the current month and year at the time of sub-area estimate and forecast development
- Commercial and multifamily vacancies in Downtown Seattle and Eastside urban centers
- Development pipeline projections for Downtown Seattle and Eastside urban centers
- Three different and independent regional econometric forecasts produced by local and national economic experts
- The PSRC's long-range small area forecasts by TAZ

CAI developed an extensive process to apply the Baseline Scenario regional estimates and forecasts to the SR 520 travel shed and influence area to develop reliable projections of households, population, and jobs at a sub-regional level. A graphical representation of this process is given in Figure 4-3.

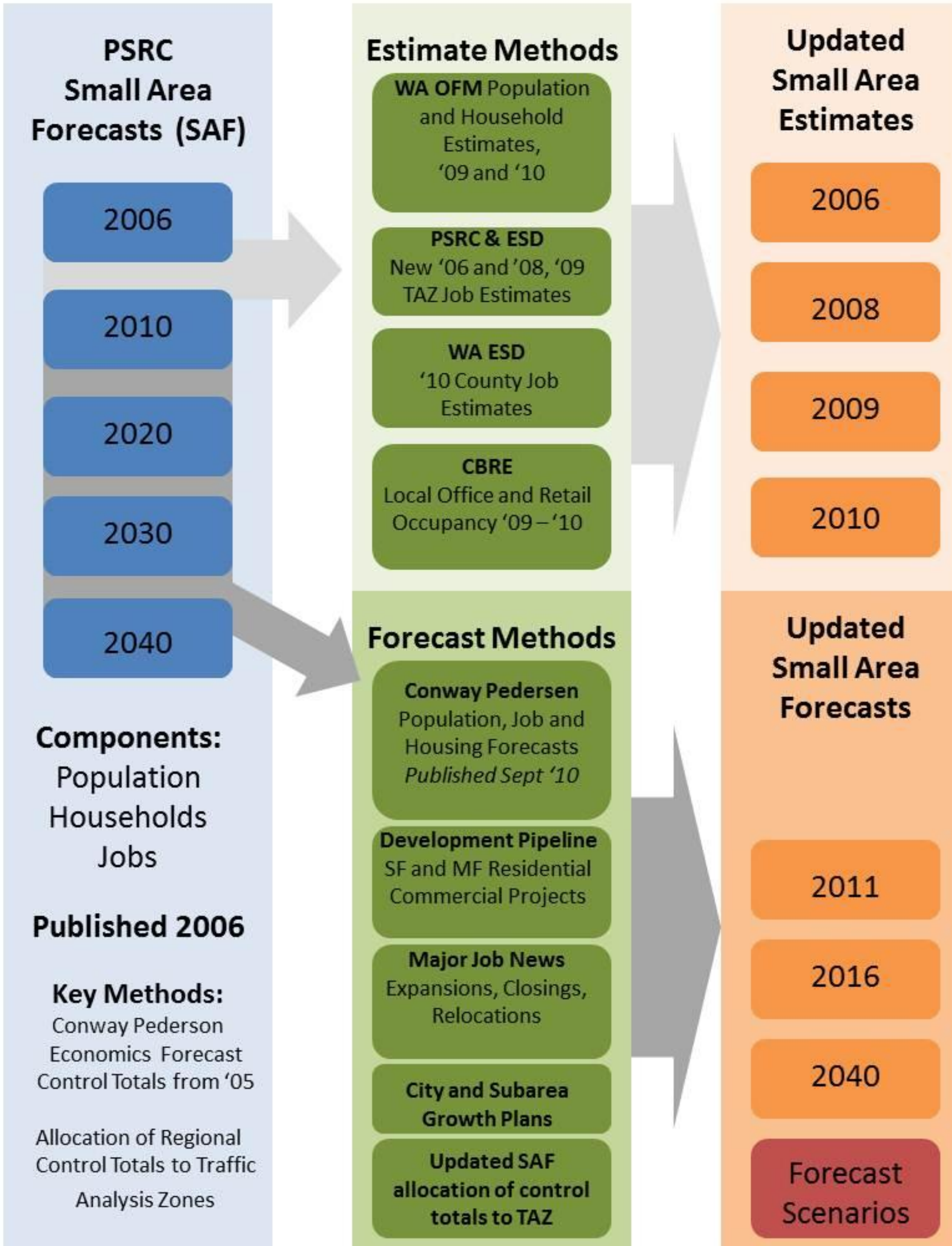
2010 Base Year Traffic Analysis Zone Estimates

An important first phase of CAI's work was to establish a confident, current year (2010) baseline understanding of where people live and where jobs are located. The PSRC small area forecasts were based on a 2006 base year (and were the only pre-existing source of sub-regional forecasts available). CAI took considerable effort to establish a 2010 baseline, which as a result reflects the impacts of the recession on the housing and jobs patterns in the region. As noted above, these estimates were based on several different sources and analyses.

For example, one important finding is that office occupancy rates in downtown Seattle had decreased while rates in downtown Bellevue had increased in recent years. Since the forecasts were developed to the TAZ level, these shifts in occupancy are directly accounted for in the modeling process. The number of work trips across the bridge may be affected by the difference in occupancy rates.

Baseline Scenario Traffic Analysis Zone Forecasts (2010-2040)

Given the new 2010 basis of TAZ estimates described above, the forecasts for beyond 2010 also needed to be changed. Updated Small Area Forecasts beyond 2010 were developed utilizing a combination of information



Source: Community Attributes, Inc., 2010

CONCEPTUAL APPROACH TO UPDATING PSRC SMALL AREA FORECASTS

FIGURE 4-3

from the Conway Pedersen regional forecasts, development pipeline analysis, major employment news, and city and sub-area growth plans. These were then translated into TAZ-level forecasts and applied to the tolling model.

Overall, the socioeconomic component of the study controlled the forecast totals to the Conway Pedersen regional totals for 2010 through 2030. A second check of the long-term forecasts was performed using additional outside growth forecasts as noted below in Alternative Scenarios.

Beyond 2020, the forecast sources do not provide future forecasts. Instead, CAI relied on the original countywide annual growth rates forecasted by PSRC in 2006. Regional forecasts for years as far out as 2030 to 2040 typically revert to a historic regional growth rate, as is the case for the three outside forecasts reviewed for CAI's work (resulting in a long-term growth forecast of 1.2 percent compound annual growth rate for jobs and 0.8 percent for population).

The near term, intra-regional TAZ forecasts (2011 and 2016) started from the newly established 2010 base year estimates and applied countywide growth forecasts by economic sector, as well as real-estate development pipeline and absorption calculations and pertinent local economic news to determine the forecasts. While controlling for the major county and regional totals noted above, the process helped determine shifts within the study area, particularly for parts of the study area with a major influence on the SR 520 bridge traffic.

Long term TAZ forecasts (2020, 2030, and 2040) were developed using a more generalized group of information. Forecasts for 2020 were based on the 2016 forecasts, but used the Conway Pedersen 2020 forecast as control totals. By using sub-area plans for parts of the study area, shifts in location of population and employment were accounted for in the 2020 forecast, most notably the Bel-Red Road Corridor plan in Bellevue and Redmond. For 2030 and 2040, the 2020 forecasts were grown by the originally estimated 2006 PSRC long range forecast growth rates, with the distribution to TAZ-level based on the incremental PSRC distribution of growth within the region from those same forecasts, on a percentage basis starting from the 2020 CAI projections.

The resulting information used as input to the tolling model was the 2010 Base Year population and employment estimates by TAZ and the Baseline Scenario population and employment forecasts for future years (2011, 2016, 2020, 2030, and 2040). The forecasts do not reflect "a return" to growth expectations prior to the recession. CAI's methods take into consideration the local and neighborhood level impacts of the recession. The regional forecasts applied take into consideration the relationship of the Puget Sound regional economy to the global and national economies.

ALTERNATIVE SCENARIOS

In order to provide additional input to the forecasting basis, other forecasts for study area socioeconomic data were reviewed. These were combined to determine Alternative Scenario area control totals. Subsequently, the same method described above was used to determine the TAZ level forecasts for the Alternative Scenarios.

The sources for Baseline Scenario and Alternative Scenario population forecasts are:

- Baseline Scenario – Conway Pedersen Economics control totals for employment
- Washington Office of Financial Management (OFM) Low Growth – Washington State OFM 2007 Growth Management Act population "low" projections for future year growth beyond the Baseline 2010 estimate
- Washington OFM High Growth – Washington State OFM 2007 growth Management Act population "high" projections for future year growth beyond the Baseline 2010 estimate

The sources for Baseline Scenario and Alternative Scenario employment forecasts are:

- Baseline Scenario – Conway Pedersen Economics control totals for employment
- Woods & Poole Scenario –Woods & Poole Economics, Inc. January 2010 control totals for employment for future year growth beyond the 2010 Baseline estimate
- Moody's Economy Scenario – Moody's Economy.com October 2010 control totals for employment for future year growth beyond the 2010 Baseline estimate

The results of the Baseline Scenario and Alternative Scenario analyses summarized for the entire region are provided in Tables 4-5 and 4-6 and graphically shown in Figures 4-4 and 4-5. These tables and figures also show the original PSRC 2006 Small Area Forecasts (SAF) results for the entire region.

The estimates and forecasts above show population figures for the Baseline Scenario are a little below the PSRC 2006 forecast. This is logical given the overall downturn in the economy since that time. The Baseline Scenario population forecast also falls well in between the State OFM's low and high forecasts, being closer to the low forecast. Consequently, for population, there is likely more upside potential than downside potential.

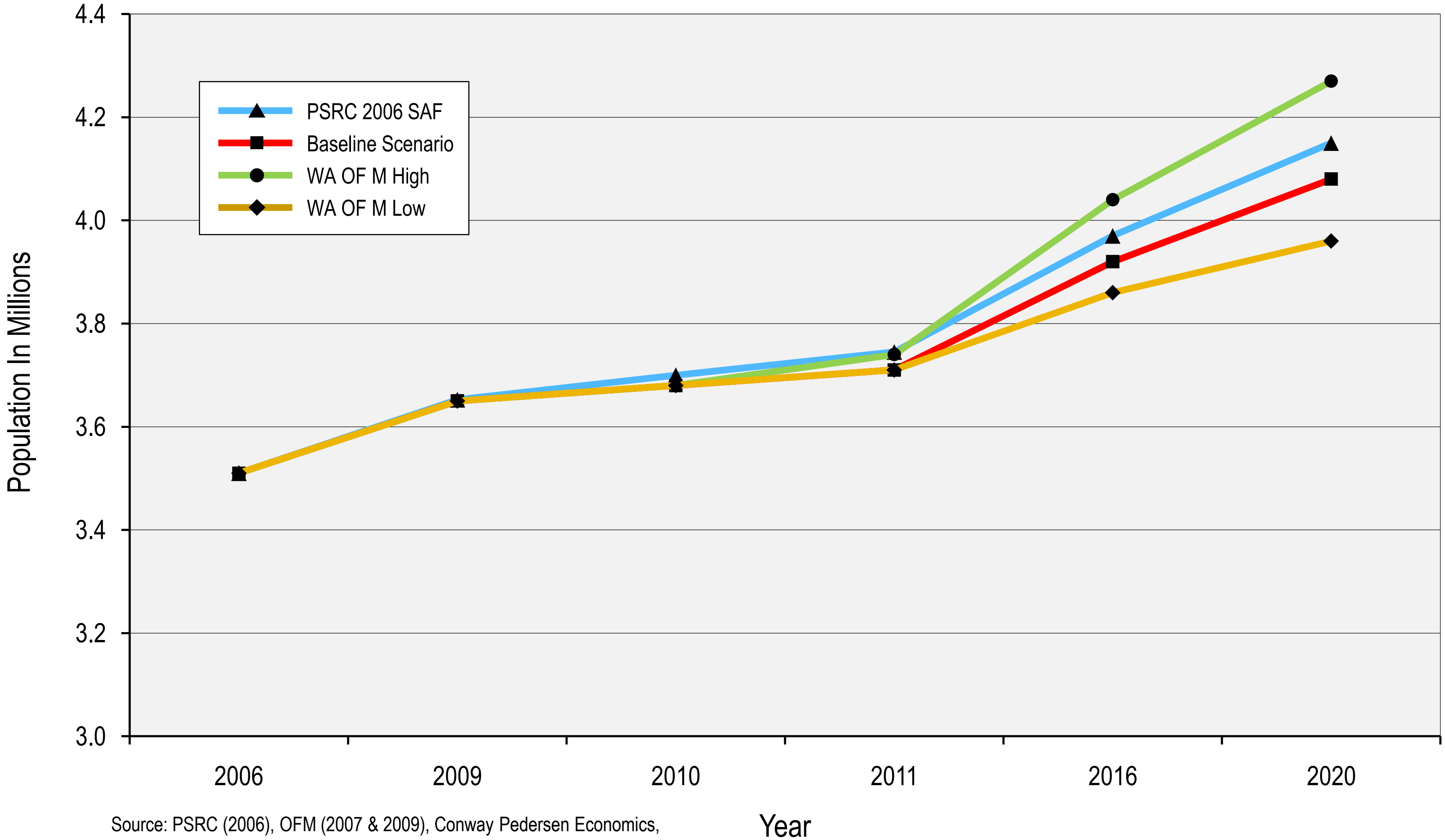
The employment Baseline Scenario and Alternative Scenario estimates and forecasts are all well below the PSRC 2006 forecast, indicating the recession has had a greater impact on employment than population. There is no high or low forecast available, but the Baseline Scenario is similar to the Moody's Economy forecast while the Woods & Poole forecast is significantly lower.

Table 4-5
Comparison of Population Forecast Scenarios
Central Puget Sound Region, 2010 - 2040
(Numbers in Millions)

Population	2006	2009	2010	2011	2016	2020	2030	2040
Four County Region								
PSRC 2006 SAF	3.51	--	3.70	--	--	4.15	4.54	5.00
Baseline Scenario	**3.51**	**3.65**	**3.68**	**3.71**	**3.92**	**4.08**	**4.47**	**4.91**
WA OFM High	3.51	3.65	3.68	3.74	4.04	4.27	4.82	5.32
WA OFM Low	3.51	3.65	3.68	3.71	3.86	3.96	4.14	4.57
% Difference from Baseline								
PSRC 2006 SAF	0.0%	--	0.5%	--	--	1.7%	1.6%	1.8%
Baseline Scenario	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
WA OFM High	0.0%	0.0%	0.0%	0.8%	3.1%	4.7%	7.8%	8.4%
WA OFM Low	0.0%	0.0%	0.0%	0.0%	-1.5%	-2.9%	-7.4%	-6.9%

PSRC is the Puget Sound Regional Council; SAF is Small Area Forecasts

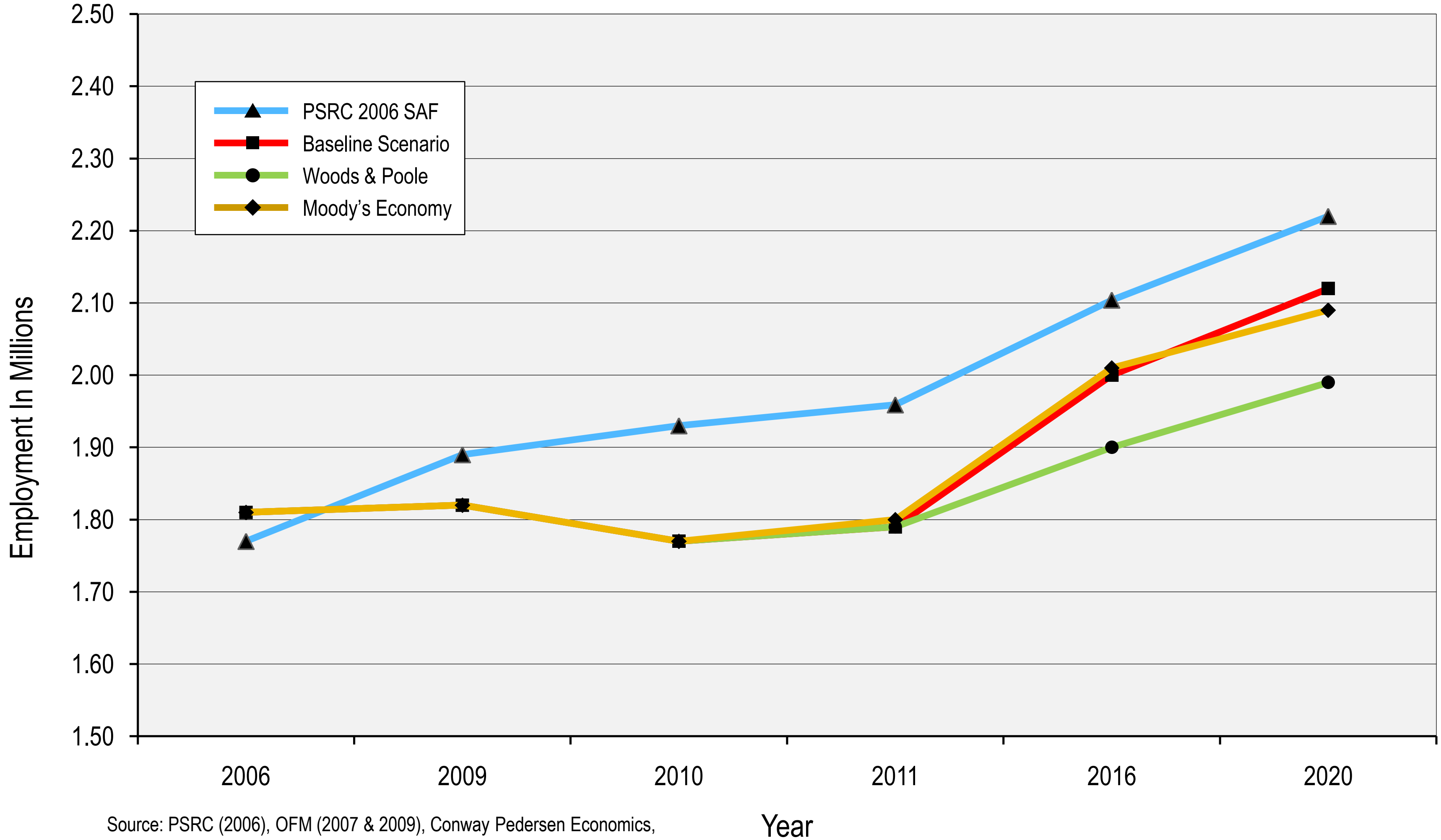
WA OFM is the Washington Office of Financial Management



Source: PSRC (2006), OFM (2007 & 2009), Conway Pedersen Economics, Community Attributes, Inc., 2010

COMPARISON OF POPULATION FORECAST SCENARIOS, 2006-2020

FIGURE 4-4



Source: PSRC (2006), OFM (2007 & 2009), Conway Pedersen Economics, Community Attributes, Inc., 2010

COMPARISON OF EMPLOYMENT FORECAST SCENARIOS, 2006-2020

FIGURE 4-5

Table 4-6
Comparison of Employment Forecast Scenarios
Central Puget Sound Region, 2010 - 2040
(Numbers in Millions)

Employment (millions)	2006	2009	2010	2011	2016	2020	2030	2040
Four County Region								
PSRC 2006 SAF	1.77	--	1.93	--	--	2.22	2.50	2.79
Baseline Scenario	1.81	1.82	1.77	1.79	2.00	2.12	2.39	2.70
Woods & Poole	1.81	1.82	1.77	1.79	1.90	1.99	2.24	2.51
Moody's Economy	1.81	1.82	1.77	1.80	2.01	2.09	2.30	2.66
% Difference from Baseline								
PSRC 2006 SAF	-2.2%	--	9.0%	--	--	4.7%	4.6%	3.3%
Baseline Scenario	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Woods & Poole	0.0%	0.0%	0.0%	0.0%	-5.0%	-6.1%	-6.3%	-7.0%
Moody's Economy	0.0%	0.0%	0.0%	0.6%	0.5%	-1.4%	-3.8%	-1.5%

PSRC is the Puget Sound Regional Council; SAF is Small Area Forecasts

Since both population and employment affect travel demand, the effect of lower population and/or employment growth is considered a downside risk for toll revenues. Consequently, sensitivity tests were formulated for this study that include lower growth rates and consequential lower travel demand. These are covered in Chapter 8.

Additional Forecast Reviews

Since the completion of the Baseline Scenario forecast, Census 2010 information has become available for review. Table 4-7 below shows a comparison of the CAI estimates for 2010 with the actual U.S. Census 2010 estimates for 2010.

No data from the U.S. Census 2010 had been released by autumn 2010, when the socioeconomic basis was last updated. (The U.S. Census did release their annual estimates of counties and states, which inform the Washington State OFM's estimates of population and housing, discussed in greater detail in the previous section.)

Detailed Census 2010 tables for Washington State were released on May 19, 2011. Comparison of this 2010 census data by census tract to the projections for 2010 from our Baseline Scenario show that among cities and counties, the CAI projections are similar to the Census findings as shown in Table 4-7.

For the larger cities of Seattle and Bellevue, the census estimates are lower than our Baseline Scenario by 0.5 percent and 0.8 percent for 2010. The census was 1.4 percent and 1.5 percent lower for Kirkland and Redmond. For King County as a whole, the Census is higher than our Baseline Scenario by 0.6 percent. For the four-county region, the Census is higher than our Baseline Scenario by 0.2 percent.

Table 4-7
Comparison of 2010 Census Data and Baseline Forecasts

	Population		Census 2010 v. Baseline Scenario	
Population, 2010	**Census 2010**	**Baseline Scenario**	**Difference**	**% Difference**
Seattle	605,202	608,100	-2,898	-0.5%
Bellevue	125,951	127,000	-1,049	-0.8%
Redmond	61,265	62,200	-935	-1.5%
Kirkland	49,384	50,100	-716	-1.4%
King County	1,931,249	1,919,600	11,649	0.6%
Four County Region	3,690,942	3,683,700	7,242	0.2%

Source: U.S. Census 2010; Community Attributes 2010

VEHICLE MILES OF TRAVEL LAW

Washington State has a law containing a goal to reduce regional vehicle miles of travel (VMT) per person with milestone years of 2020, 2035, and 2050. The interpretation and implementation of this law has not been well-defined at this point. Consequently, in its most recent long-range transportation planning process, the Puget Sound Regional Council analyzed statewide and regional trip-making data to determine a benchmark statewide daily per capita VMT. The reduction schedule was applied to the benchmark level and compared to the resulting area per capita VMT resulting from the Long Range Transportation Plan preferred scenario. This comparison showed that the region's transportation plans comply with this state law through the 2035 goal, but do not reach the 2050 goal. WSA's tolling model for this study is based off the same model used to generate these results. Thus, it was assumed the WSA results do not need further adjustment through the 2035 time horizon and are compliant. After 2035, since no regional implementation plan exists to reach the VMT reduction goal in 2050, WSA did not make any further adjustments in the traffic and revenue forecast.

CONCLUSIONS

A reasonable estimate of current population and employment at the sub-regional level (TAZ level) was developed using state population and employment figures, PSRC current area estimates, and collected source data such as real-estate summaries. Future population and employment forecasts through 2020 are generated based on overall control to the Conway Pedersen forecasts for the Central Puget Sound Region, which account for the recent recession. Beyond 2020, the forecasts are driven by PSRC forecasted marginal growth rates by TAZ and marginal growth rates by county from 2020 to 2030.

The result of this process is an updated set of forecasts grounded in a reliable 2010 base year set of estimates, and driven by the latest forecasts available at the time, fully informed by the impacts of the recession on the central Puget Sound region, as well as national and global economic outlooks. The forecasts are an objective economic outlook from 2010 looking to the future, with no attempt to "catch up" to forecasts produced before the recession impacts were felt nationally or locally.

The forecasted growth is distributed using a combination of the PSRC 2006 estimate and forecast distribution of growth, local real estate market information, major employer and development news, and local and sub-area plans. This process resulted in updated forecasts by TAZ for input into the SR 520 toll model developed by WSA and based on PSRC's regional model. The independent analysis also included alternative growth scenarios.

An important conclusion is that growth is not critical for the SR 520 bridge to be in high demand due to the area's existing density and major urban centers on both sides of the lake. However, in the long term growth forecasts for the surrounding areas suggest an increasing demand for trips across the bridge.

CHAPTER 5

TOLLING OPERATIONS

The Washington State Department of Transportation (WSDOT) intends to collect tolls on the existing State Route 520 (SR 520) floating bridge and on a future replacement bridge span crossing Lake Washington. Approval has been granted by the State legislature to toll the existing SR 520 bridge, in advance of the construction of the new bridge. Tolls will also be collected on the new bridge span, which is anticipated to open to traffic by 2016.

Toll rates will vary by time of day and day of week (weekday versus weekend day) with higher tolls during peak demand periods. The variable pricing will allow for better traffic operations management of the facility during peak periods. This pricing will also potentially lower diversion away from SR 520 due to tolls during off-peak periods resulting in better revenue collection during these times. During construction, tolls will not be collected during the overnight period (defined as 11:00 pm to 5:00 am) on the existing bridge because of expected impacts. Once construction of the replacement bridge is complete, from Fiscal Year (FY) 2017 onwards, tolls will be collected over the entire day. On the existing SR 520 floating bridge, a weekday toll schedule will apply to all weekdays, and a separate weekend toll schedule will apply to both weekend days. Major holidays that fall on weekdays will use the weekend toll schedule. Similarly, from FY 2017 onwards, toll collection on the replacement bridge will be based on weekday and weekend day toll schedules. Chapter 6 provides more information on the toll schedules assumed in this study.

This chapter summarizes the tolling assumptions used in developing traffic and revenue estimates. Two payment types were assumed in this study: Account-based and Pay-by-Mail. Account-based toll payment provides two options – via Good To Go! passes or license-plates. The first option requires motorists to establish a prepaid account, obtain a Good To Go! transponder and register their vehicle license plate with the account. The second option requires motorists to establish a prepaid account and register their vehicle license plate. Pay-by-Mail toll payments will also provide two options – through customer-initiated payments and following receipt of an invoice in the mail. The assumed market shares of each payment type are presented later in this Chapter.

Initial assumptions of market share by payment type were developed based on market research conducted by WSDOT as well as license plate surveys conducted on the SR 520 bridge during sample days. These market share assumptions were used as inputs to traffic and revenue modeling conducted by Wilbur Smith Associates (WSA). The modeling also incorporated toll price differentials between the two payment types. Information regarding estimated market share by payment types resulting from the toll diversion analysis is presented in Chapter 6.

The assumed toll collection system and payment options for SR 520 are discussed in further detail in the following sections.

DATA SOURCES

WSA reviewed the following documents in conducting the analysis presented herein:

- WSDOT's SR 520 Corridor Tolling & Customer Service Center Preliminary Concept of Operations, dated August 12, 2008
- WSDOT's Request for Proposal, ACQ-2009-0530-RFP, to Supply, Install, Maintain a Toll Collection System, dated June 15, 2009
- WSDOT's Request for Proposal, ACQ-2009-0515-RFP, to Establish and Operate a Statewide Customer Service Center, dated June 15, 2009
- Recommendations of the Expert Review Panel of the Joint Transportation Committee of the Washington State Legislature, dated September 9, 2009
- WSDOT's preliminary marketing plans for the project

These documents were reviewed to provide an understanding of the proposed toll system and Customer Service Center (CSC). Subsequently, discussions with WSDOT and consultants involved with the implementation of the tolling system and CSC were conducted to clarify developments since the issuance of these documents.

SR 520 TOLL COLLECTION SYSTEM SUMMARY

WSDOT has chosen to implement a variably-priced, cashless tolling system on the SR 520 bridge. The all-electronic approach will allow vehicles to travel through the corridor at highway speeds without stopping to pay the toll, while minimizing right-of-way requirements and allowing faster construction and installation compared to conventional toll plazas.

From the commencement of tolling (FY 2012) until the new bridge opens, tolls will be collected at the east high-rise section of the SR 520 bridge. Once the new bridge opens, tolls will be collected at a location on the eastern shore of Lake Washington. Tolls will be collected in both directions via electronic toll collection and video collection systems. Electronic toll collection will be conducted using WSDOT's Good To Go! passes. SR 520 users who do not have Good To Go! passes will be tolled by capturing their vehicle license plates using cameras.

SR 520 Payment Types

The WSDOT toll collection system will provide customers two ways of paying their toll:

- Account-based, either via transponders or registered license plates linked to a prepaid account
- Pay-by-Mail, in which unregistered toll users will have a bill mailed to them after using the facility

Different costs of toll collection are associated with each payment type including processing costs and revenue losses. The assumed toll differentials between payment types are shown in Table 5-1 for a two-axle vehicle.

Table 5-1
Two-Axle Vehicle Base Toll Differentials

Payment Types	Toll Rate
Account-based	Base Toll Rate
Pay-by-Mail	Base Toll Rate + $1.50 differential

The payment types are outlined in further detail below.

Transponders Linked to a Prepaid Account - Transponder payments will involve establishing a toll account, pre-payment of tolls, purchase of one or more transponder passes, and allowing for automatic replenishment of account balances through a credit card or linked bank account. Customers will also have the option of establishing an anonymous account by depositing cash payments into their account at a CSC. Automatic replenishment will not be available to anonymous account holders. Instead, anonymous account holders will need to monitor their usage and return to the CSC to replenish their accounts.

Transponder payments will use WSDOT's Good To Go! pass program. Good To Go! is currently in use on the Tacoma Narrows Bridge and the SR 167 High Occupancy Toll lanes. In conjunction with the implementation of tolls on SR 520, WSDOT is expanding the transponder passes available in this program to include five different options:

- Standard Sticker Pass - $5 (non-transferable)
- Standard Movable Pass - $8 (can be moved from vehicle to vehicle)
- Movable Pass with On/Off options - $12 (for those who also use WSDOT's High Occupancy Toll lane system)
- Motorcycle Sticker Pass - $8 (transparent small format pass for motorcycle headlamps, non-transferable)
- External Mount License Plate Pass - $12 (an option for those who do not want a windshield pass or for vehicles with other physical characteristics that may interfere with windshield-based passes)

Pass prices are valid as of summer 2011. All transponders will be readable at full highway speeds.

License Plate Linked to a Prepaid Account - Similar to a transponder linked to a prepaid account, license plate accounts will require customers to link their license plates with their prepaid account, but will not require a transponder for toll payment. Automatic replenishment will be available for accounts through linked credit cards or bank accounts. Anonymous accounts will not be allowed for this type of payment. The registration of the vehicle license plate, vehicle type, and prepayment will allow swifter and less expensive processing of payments from video license plate images than via Pay-by-Mail, but does involve additional processing than transponder-based toll payments. Consequently, WSDOT may charge a small fee above the transponder toll rate to cover the added costs of processing.

Pay-by-Mail - Vehicles not registered with the CSC through a prepaid account will receive invoices via mail to the registered vehicle owner. Due to the cost of video processing, license plate look-up in motor vehicle databases, mailing invoices, processing payments, and possible losses throughout the chain of this type of payment, these customers will pay a toll differential of $1.50 in addition to the transponder toll rate.

Customer Initiated Payment – (Note: WSDOT is considering offering this additional form of payment, but it will likely not be available when tolling commences.) A customer who does not have one of the prepaid accounts noted above may choose to pay within 72 hours (3 days) after using the facility, essentially setting up a temporary tolling account. In this case, the customer will pay for tolls online or over the phone. Direct payment at the CSC will also be accepted. In this way, the tolling system can look for the specific license plate in the regular video license plate image captures and credit the toll to that transaction, thereby eliminating the need to mail the customer an invoice. Since the mailing and toll collection costs of video tolling are reduced in this case, customers choosing this type of payment may receive a small discount on Pay-by-Mail invoice amount.

Customers will be able to register a combination of transponders and license plates on a particular personal prepaid account. Thus, a regular commuter can get a transponder for their main vehicle, and register other less frequently used vehicles from their household as license plates linked to that account. (Any combination of up to six vehicles is possible.) This has the advantage that households do not have to buy multiple transponders for vehicles which are used infrequently on the toll facilities while still keeping all vehicles registered under one account. Also, a movable transponder will be made available for those who wish to transfer the transponder between vehicles.

Customers with more than six vehicles to be registered to a transponder account will have a commercial account that operates similar to the personal account.

SR 520 Vehicle Classification and Exemptions

Vehicles will be tolled on the SR 520 bridge according to vehicle classes by number of axles. These are:

2 Axles – including motorcycles and two-axle - six-tire vehicles
3 Axles – including two-axle vehicles towing one-axle trailers
4 Axles – any combination of four axles
5 Axles – any combination of five axles
6 or more Axles – any combination of six or more axles

The toll rates for multiple-axle vehicles will be based on the axle multiple of the appropriate two-axle vehicle base toll rate for primary payment types: Account-based and Pay-by-Mail. For instance, a four-axle vehicle using a transponder will pay twice the two-axle base rate for regular Account-based transponder transactions. Likewise, a four-axle vehicle will be billed twice the two-axle rate for Pay-by-Mail payments. Chapter 6 presents the detailed toll schedule assumed in this study.

A variety of toll exemptions will be implemented on the SR 520 bridge. Some are being initiated by State policy while others are by agreement between the State and Federal Highway Administration as part of the Urban Partnership Agreement which applies to the SR 520 bridge. These exemptions are outlined as follows:

- After the new bridge span opens, it is assumed high occupancy passenger vehicles with three or more occupants (HOV3+) will be exempt from paying tolls when traveling in the high occupancy vehicle (HOV) lane. Because the existing bridge lacks HOV lanes needed for HOV enforcement, all passenger car vehicles including HOVs will be tolled on the current bridge.
- Agency-owned and branded transit vehicles (such as King County Metro buses and Sound Transit buses) will be required to have a transponder but will not be tolled on either the existing or new bridges.
- Privately-owned transit vehicles which operate on a fixed route and regular schedule (such as the Microsoft Connector system) will be required to have a transponder but will not be tolled on either the existing or new bridges.
- Agency Sanctioned Vanpools (such as those provided by King County Metro) and private ride share vehicles which are certified under the current Washington Department of Licensing ride share program will both be required to have a transponder but will not be tolled. Recertification of such vehicles may be required annually.
- Washington State Police servicing the SR 520 bridge and corridor will not be tolled.
- WSDOT SR 520 bridge maintenance vehicles will not be tolled.
- Emergency vehicles on emergency calls will not be tolled. The vehicle must be equipped with a transponder associated with an authorized prepaid account or an authorized representative may apply for a toll credit for each emergency trip.
- Tow trucks authorized by the Washington State Patrol that are responding to calls to clear blocking vehicles from the toll facility will not be tolled. The vehicle must be equipped with a transponder associated with an authorized prepaid account or an authorized representative may apply for a toll credit for each authorized trip.
- Any vehicle owned or operated by a foreign government where the U.S. Department of State provides annual certification of the vehicle and license plate will not be tolled. These vehicles will not be required to have a transponder.

SR 520 Marketing Activities and Incentives

An extensive Good-To-Go! tolling education and outreach campaign began in May 2010 that included presentations, materials distribution, briefings, event booths, social media, employer partnerships, and public relations. Between May 2010 and January 2011, over two million people had been reached through outreach. This includes:

- 120 through presentations, briefings, events
- 2.2 million via e-mail, handouts, brochures
- 17,000 signed up on interest list (8,000 in January)
- Over 1.4 million Twitter impressions (over 700,000 in January)
- Over 1,200 media articles and blogs
- 600,000 web page views (January page views were three to four times that of previous months)

In addition, an extensive advertising campaign has been undertaken that includes online ads, radio and television spots, billboards, bus ads and wraps, and newspaper ads.

Market research surveys were conducted in Fall 2009, Spring 2010, and Fall 2010, and another will be conducted following the commencement of tolling to measure awareness and messaging for the tolling program.

In February 2011, WSDOT opened the CSCs to sign up drivers for the Good-To-Go! program and register transponder and video toll users.

Transponder Sales Information

To encourage early sign ups for Good To Go! transponders and accounts, WSDOT launched a limited-time incentive program that provided $10 in toll credit for each new Good To Go! transponder account that was activated between February 2011, when the new passes became available, and April 15, 2011. In addition, WSDOT is offering a 20 percent discount on transponder purchases for large groups or employers who undertake a major Good-To-Go! outreach campaign to their customers, employees, or members. Approximately 15 such groups have partnered with WSDOT and will be participating in this promotion.

As a result of the marketing initiatives from WSDOT, there has been a surge in transponder sales. Based on information obtained from WSDOT in June 2011, approximately 135,000 new transponders were issued between February 14 and June 30, 2011. This transponder sale information provides a positive indication that the transponder penetration assumed for this study will be achieved. Based on the number of transponders sold, information on trip frequency and percentage of transponder users, the current level of transponder sales supports the assumptions used in this study.

PRELIMINARY ESTIMATES OF PAYMENT MARKET SHARES

WSA conducted an origin-destination survey of users of the SR 520 bridge in September 2009 with approximately 6,000 participants. (Additional details of this survey and its results are provided in Chapter 2.) The survey data was a primary source of travel information for SR 520 users applied in this analysis in addition to market research conducted by WSDOT and national experience from WSDOT's consultants and peer agencies.

Table 5-2 below summarizes the assumed market shares by payment type.

Table 5-2
Estimated and Future Year Assumed Market Shares

	Percentage Share By Year				
	FY 2012	FY 2016	FY 2017	FY 2024	FY 2031+
Account-based					
Primary - Transponder Pass	53.0%	67.0%	67.0%	76.6%	82.0%
Variation - License Plate	9.5%	7.0%	7.0%	4.2%	3.0%
Total Pre-established Accounts	62.5%	74.0%	74.0%	80.8%	85.0%
Pay-by-Mail					
Primary - Pay by Mail	33.8%	23.4%	23.4%	17.3%	13.5%
Variation - Customer-Initiated Payment	3.7%	2.6%	2.6%	1.9%	1.5%
Total Non-Established Payment	37.5%	26.0%	26.0%	19.2%	15.0%
Total Market	100.0%	100.0%	100.0%	100.0%	100.0%

It should be noted that the market shares above represent initial assumptions based on existing travel patterns, prior to conducting the toll diversion analysis. The resulting market shares, after the toll diversion analysis, were used in developing revenue estimates. Chapter 6 provides additional detail on how these and other inputs were used to develop traffic and revenue forecasts.

CHAPTER 6

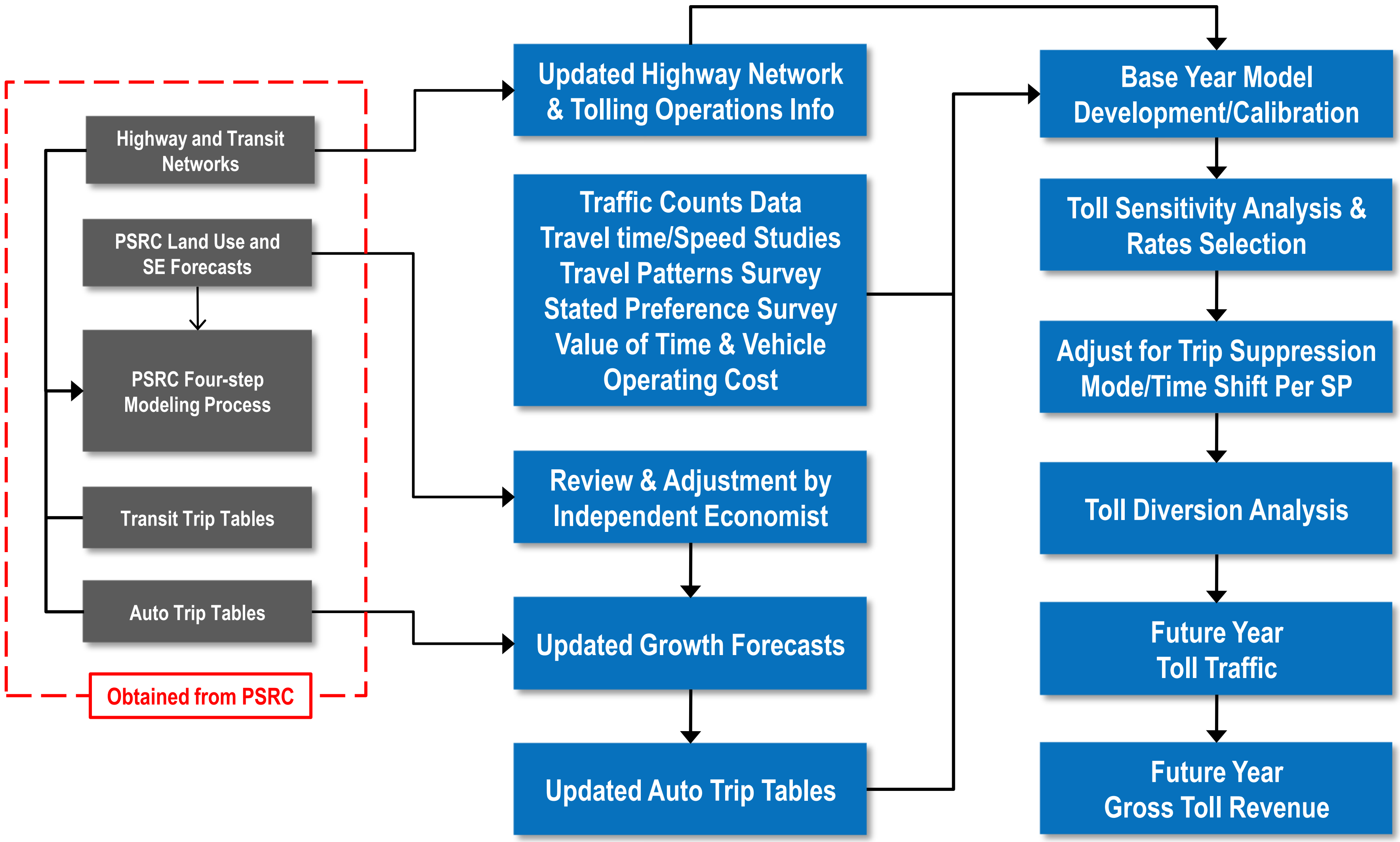
TRAFFIC & REVENUE APPROACH

This chapter presents a summary of the traffic and revenue analysis conducted for the State Route 520 (SR 520) bridge. In addition to an overview of the travel demand modeling process, information is also presented on the regional highway improvement program, basic assumptions upon which the traffic and revenue forecasts are based, a toll rate sensitivity analysis, and the toll rate structure used in this study.

ANALYTICAL METHODOLOGY

In estimating the revenue potential of the SR 520 bridge, it is incumbent on the State to make prudent assumptions that will not overstate revenue receipts. Because of this goal, traffic forecasts in this evaluation may differ from those used for the SR 520 bridge replacement National Environmental Policy Act (NEPA) process and for operational planning purposes. For NEPA environmental studies, the project team must make assumptions that will not understate traffic and its impact on the environment. Traffic volumes in this report are intended solely for the purposes of developing appropriate revenue forecasts for project financing and are not intended to replace the SR 520 NEPA analysis results.

This section describes the general procedures used to develop forecasts of annual toll traffic and gross toll revenues. Figure 6-1 depicts the process schematically. The initial step was to obtain regional planning model datasets for the Puget Sound region. The model data files were obtained by Washington State Department of Transportation (WSDOT) from the Puget Sound Regional Council (PSRC). In addition to model routines, input files representing highway and transit networks, data on land-use and socioeconomic forecasts, and trip tables representing vehicle trips were provided to Wilbur Smith Associates (WSA). The PSRC regional model is implemented in the EMME software platform. WSA's tolling methodology and algorithms are implemented in the Cube/Voyager software platform. Con-



PSRC is the Metropolitan Planning Organization for the Seattle region

OVERALL ANALYTICAL PROCESS

FIGURE 6-1

sequently, the data files were first converted to the WSA format for use in subsequent steps.

As previously discussed, WSA performed several types of studies and surveys specific to the SR 520 corridor, including:

- Gathering available traffic count data and reports
- Performing vehicle occupancy and truck classification studies
- Travel time/speed studies
- Travel pattern survey (including Origin-Destination survey)
- Stated preference survey
- Economic growth review

Traffic data was obtained from WSDOT's traffic count stations for the years 2008 through 2010. In addition, WSA conducted vehicle occupancy and truck classification studies using video cameras in November 2009. This data was used in the calibration stage of the model. Travel time and speed data was collected by WSA staff using Global Positioning System (GPS) equipped vehicles in November 2009 and was also used for the purposes of model calibration.

A travel pattern survey, conducted by WSA in September 2009 and including 6,400 participants, was a major effort to understand the current travel patterns of the SR 520 bridge users. Information obtained from this survey was used to refine the original trip tables. A stated preference survey of approximately 2,000 participants was conducted by Resource Systems Group to determine travelers' likely response to tolls on the SR 520 bridge in terms of their trip making.

An independent review of economic growth forecasts was conducted by a local economic forecasting consultant who included impacts of the recent recession on short and long-term growth forecasts for the region as a whole. The most recent population, employment, and economic activity data was used for this purpose, primarily from 2009 and the first half of 2010. Updates to the PSRC socioeconomic forecasts developed in this effort were incorporated into the trip tables.

The highway networks were updated to include the fields necessary to perform toll diversion calculations and also to better represent traffic movements on SR 520 and I-90 bridges. Model modifications were made to allow accounting for possible suppression of trips or shifting to non-automobile modes due to tolling.

After the updates of trip tables and highway networks using the data and surveys were completed, WSA developed a toll diversion model for tolling analysis of the SR 520 bridge. Prior to tolling analysis, the model was calibrated using 2010 hourly traffic counts and travel time data under toll-free operation.

The calibrated model was then used for the analysis of a wide range of tolling scenarios. For each scenario, a set of traffic and revenue forecasts was developed. A final set of toll rates was then adopted by the Washington State Transportation Commission in January 2011. These toll rates were used for the final investment grade tolling scenario and estimation of traffic and revenue for a long term time horizon. The years modeled were Fiscal Year (FY) 2012, FY 2016, FY 2017, FY 2024, FY 2031, and FY 2056.

FY 2012 was modeled because it is the start of tolling, and FY 2016 is the last year before completion of construction. FY 2017 is the first year with full capacity operation. FY 2024 was modeled in consideration of the fact that major transit upgrades including East Link are expected to be implemented by then. The trip tables for FY 2024 were developed using FY 2021 and FY 2031 data from the PSRC model.

As the final step, a series of tests were conducted to provide a measure of the sensitivity of forecasted traffic and revenue to changes in key study assumptions. These tests covered a range of potential risk factors, such as reduced growth forecasts, reduced values of time, alternative market shares of Account-based and Pay-by-Mail, and fuel price increases.

Further discussion of the above methodology is provided later in this chapter.

PRIMARY INPUTS

MAJOR COMPONENTS OF TRAVEL MODEL

The primary components of the travel demand forecasting models include a definition of the sub-areas of the analysis region called traffic analysis zones (TAZs), a simplified representation of the roadway system called the Highway Network, and a set of matrices which are dimensioned in accordance with the TAZ system and highway network which are called the trip tables.

TRIP TABLES

For the trip tables, all vehicle classes from the PSRC regional model were retained. The following classes of trips by income level, purposes, and vehicle types were used:

- Single Occupant Vehicles (SOV) by Household Income Group
  - Home-Based Work - Low Income (Income Class1)
  - Home-Based Work - Low-Medium Income (Income Class 2)
  - Home-Based Work - Medium-High Income (Income Class 3)
  - Home-Based Work - High Income (Income Class 4)
  - Non-Work SOV
- High Occupant Vehicles (HOV):
  - HOV2 (2 occupants)
  - HOV3+ (3 or more occupants)
  - Vanpools (peak periods only)
- Trucks
  - Light Trucks
  - Medium Trucks
  - Heavy Trucks

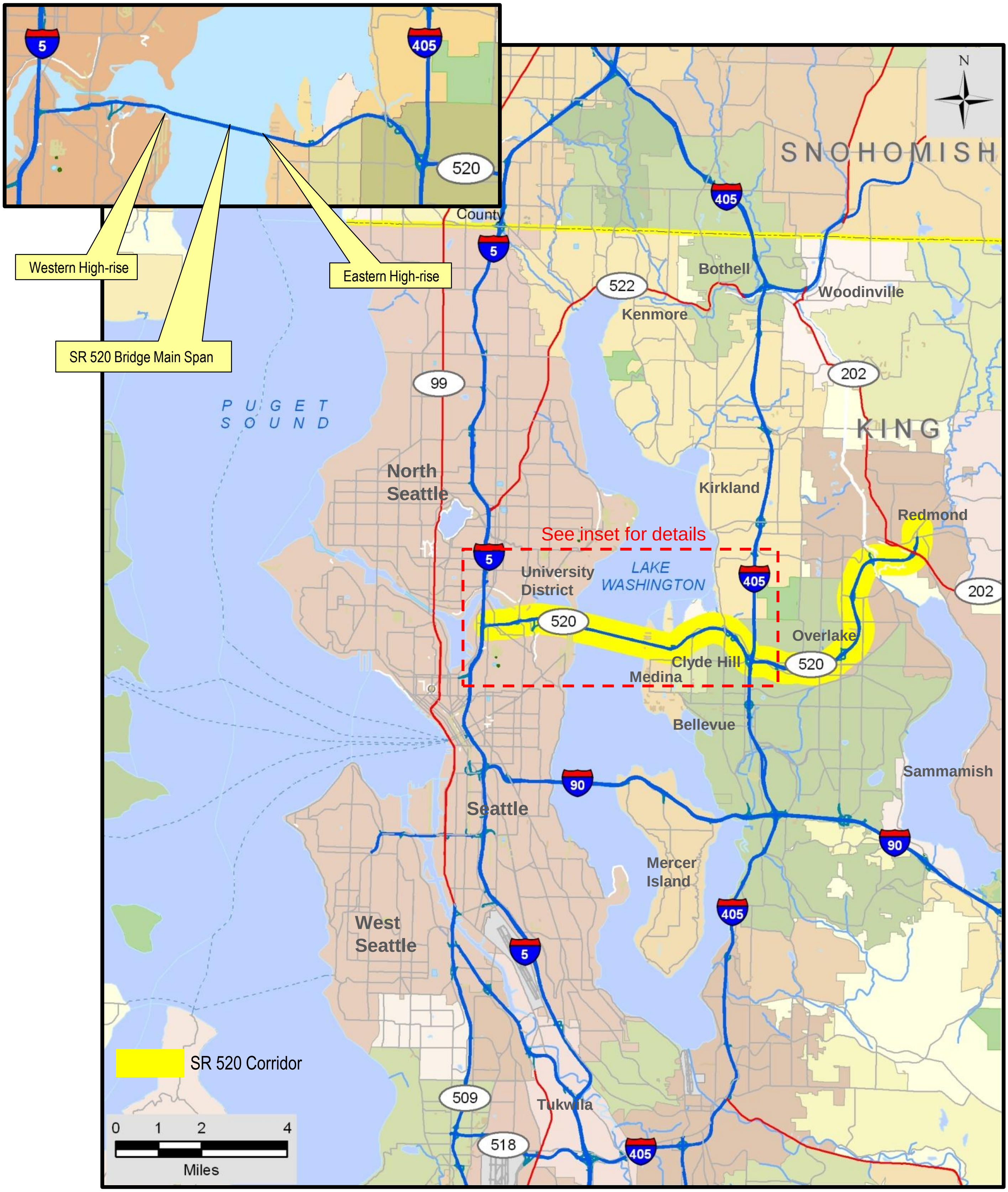
Home-Based Work trips are work trips originating from home. The income classes in terms of annual household income in 2010 dollars, are:

- Income Class 1: < $32,000
- Income Class 2: $32,000 - $58,000
- Income Class 3: $58,000 - $96,000
- Income Class 4: > $96,000

HIGHWAY NETWORKS

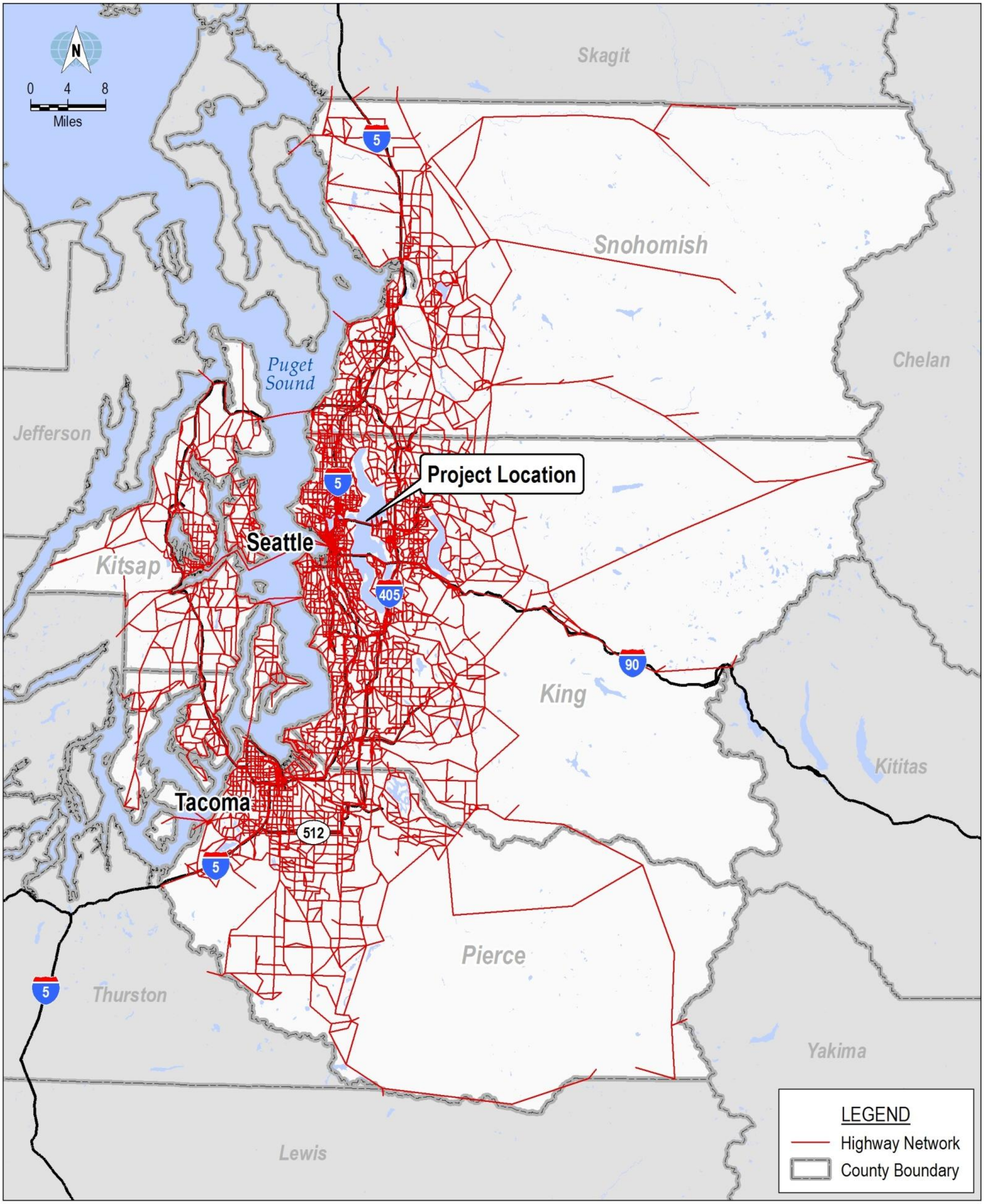
In developing the highway networks, all the important link fields, such as speed, capacity, number of lanes, and volume-delay function designations were inherited from the PSRC model and later refined. A review of the regional transportation plan documents was performed to ensure that the funded projects assumed in the long range plan are also included in the network being used for the current study. Representative highway networks were developed for each of the modeling years: 2010, 2015, 2016, 2023, and 2030. Figure 6-2 shows the project in the regional context and Figure 6-3 shows the overall extent of the highway networks.

The highway network before and after the construction of the new bridge reflects a difference in link capacity. The existing SR 520 bridge is assumed to have a capacity of 1,850 vehicles per hour per lane. This capacity was used for the period from FY 2012 through FY 2016. The new



OVERALL LOCATION OF SR 520 BRIDGE

FIGURE 6-2



HIGHWAY NETWORK

FIGURE 6-3

bridge is assumed to have a capacity of 2,000 vehicles per hour per lane to account for the wider lanes and shoulders of the new bridge.

Major Seattle area highway and transit improvements assumed in the regional model pertinent to the current study are given in Table 6-1 and 6-2, respectively.

Table 6-1
Summary of Major Highway Projects in Network

Route	Expected Completion	Project Description
I-90	2012	Addition of an HOV2+ lane in each direction on the outer roadway from Mercer Island to Bellevue Way (over the East Channel Bridge) through striping, minor construction, and appropriate ramps.
I-90	2014	Addition of an HOV2+ lane in each direction on the outer roadway across Lake Washington. Closure of the reversible center roadway once the outer roadway is reconfigured. (Center roadway will be used for East Link Light Rail.)
I-405	2010	Renton widening from I-5 to SR 169. Addition of one general-purpose lane in each direction (completed)
I-405	2012	NE 8th Street to SR 520 Braided Ramps (Bellevue). Improves the I-405 / SR 520 interchange by removing a congested merge on I-405 NB south of the SR 520 interchange.
I-405	2015	Bellevue to Lynnwood Widening and Express Toll Lanes (ETL) Project:
		Conversion of existing HOV lane to ETL from SR 522 to I-405 in Lynnwood.
		Addition of new travel lane and conversion of existing HOV lane to ETL (resulting in two ETL lanes in each direction) from SR 522 to downtown Bellevue (NE 6th Street). Completion assumed in 2015.
SR 522		Business Access and Transit Lanes - added recently east to 83rd Place NE (Kenmore City Limits) and included in model for all future model years

Source: PSRC travel model data files reflecting PSRC plan, *Transportation 2040*,

Table 6-2
Summary of Major Transit Projects in Network

Expected Completion	Project Description
2010	Implementation of more frequent transit on SR 520 bridge and addition of route from Redmond to University of Washington. Total bus trips increase from 614 to 758 week-day crossings. Implemented in Fall 2010 and Spring 2011.
2016	SR 520 Bus Rapid Transit System - five routes upgraded or added with 7-10 minute peak hour and 15 minute off-peak weekday service frequencies. Utilization of improved HOV network on SR 520 corridor including reconfigured inside HOV lanes east of Lake Washington, center transit stations on east side of Lake Washington, new SR 520 bridge HOV lanes, new HOV lanes west of Lake Washington, new HOV direct access ramps at Montlake Boulevard and 108th Ave NE, and direct HOV connection from SR 520 to I-5 reversible lanes system. Assumed implementation in 2016. These projects are part of the PSRC long range plan and are assumed for the T&R study to provide a conservative estimate of potential SR 520 auto trips.
2020-21	East Link Light Rail Extension - Extension of Link Light Rail from downtown Seattle at International District Station, on I-90 corridor east to Bellevue Way or I-405 north, then north to Downtown Bellevue, and then east to Overlake Transit Center (156th Ave NE) with possible extension to Downtown Redmond.

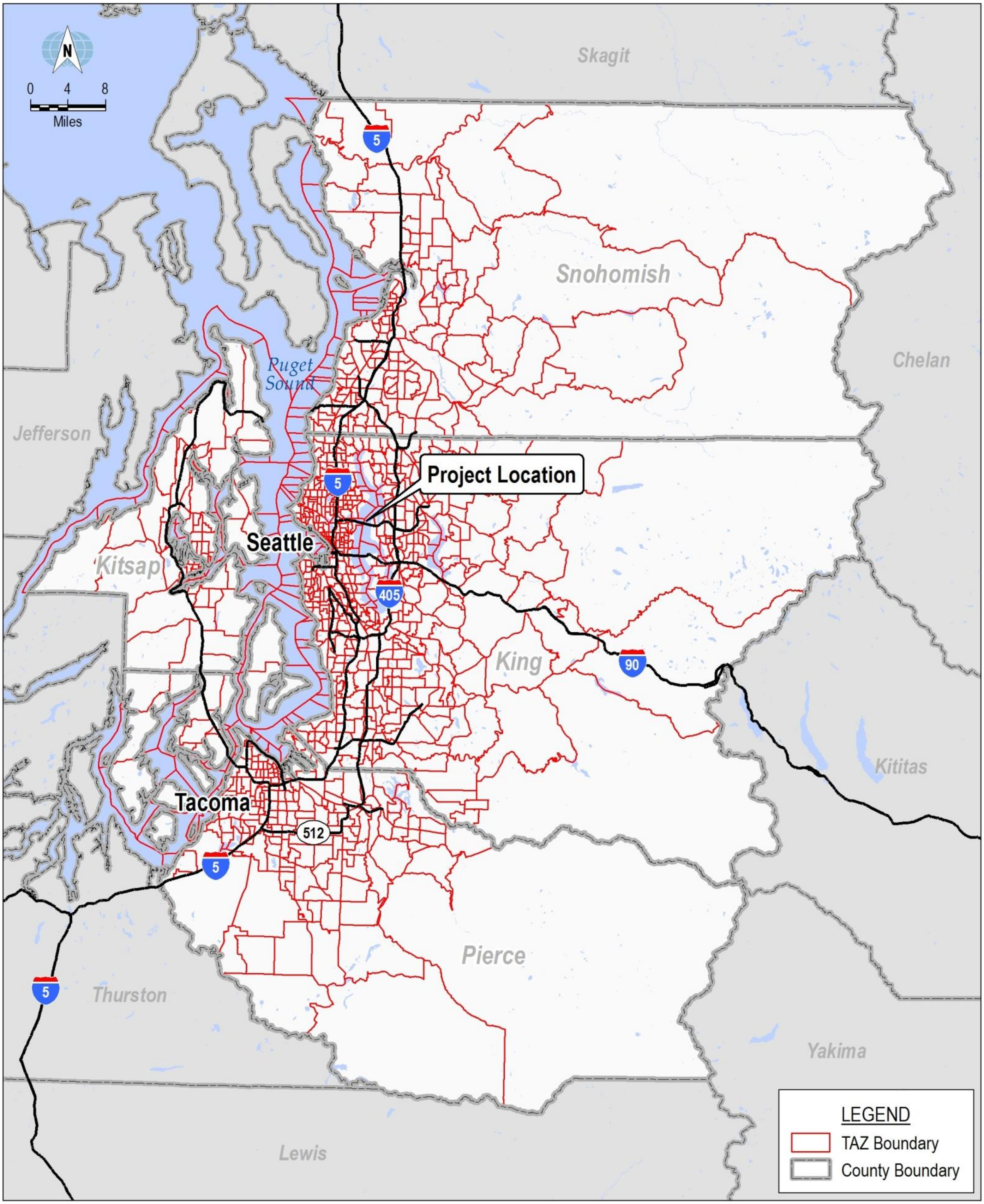
Source: PSRC travel model data files reflecting PSRC plan, *Transportation 2040* ,

TRAFFIC ANALYSIS ZONE SYSTEM

Travel forecasting models typically involve dividing a region into small areas of relatively similar characteristics called TAZs. The TAZ system was incorporated from the PSRC model, comprised of 1,200 internal and external zones. The same TAZ system was used for all analysis years. Figure 6-4 shows the extent of the TAZ boundaries relative to the regional highway map.

VALUE OF TIME

Information from the stated preference survey and socioeconomic data was used to determine values of time (VOTs) for the study as described in Chapter 3. An average VOT of $0.26 per minute was used for SOV work trips. The average HOV VOT was $0.42 per minute. Truck VOTs ranged from $0.50 to $0.60 per minute.



TRAFFIC ANALYSIS ZONES

FIGURE 6-4

Table 6-3 shows the VOT values used for specific type of trips/vehicle types. It was assumed that future increases in VOT will be in line with inflation which results in a constant real VOT (in 2010 dollars) for future years.

Table 6-3
VOT used in the SR 520 Study (2010$)

Category	VOT $/Min.	VOT $/Hr.
HBW SOV Income Group 1	$ 0.16	$ 9.60
HBW SOV Income Group 2	$ 0.23	$ 13.80
HBW SOV Income Group 3	$ 0.28	$ 16.80
HBW SOV Income Group 4	$ 0.38	$ 22.80
Non-work SOV	$ 0.23	$ 13.80
HOV2	$ 0.40	$ 24.00
HOV3+	$ 0.45	$ 27.00
Light Truck	$ 0.50	$ 30.00
Medium Truck	$ 0.50	$ 30.00
Heavy Truck	$ 0.60	$ 36.00

All values in 2010 dollars
Home-based Work Single Occupant Vehicle (HBW SOV) Income Groups:
Household Income Group 1: <$32,000/yr
Household Income Group 2: $32,00-58,000/yr
Household Income Group 3: $58,000-96,000/yr
Household Income Group 4: >$96,000/yr
Non-w ork SOV = Non-w ork Single Occupant Vehicle
HOV2 is High-occupancy vehicle, tw o occupants
HOV3+ is High-occupancy vehicle, three or more occupants

Vehicle Operating Cost

A review of vehicle operating costs was performed for various metropolitan areas of the country. An important component of operating cost is fuel costs. The operating cost used for FY 2012 for passenger cars was based on an average gasoline cost of $3.86 per gallon ($3.77 in 2010 dollars) and an average 19 miles per gallon fuel economy.

Future assumptions of gasoline price utilize the State of Washington's gas price forecasts as documented in the "*June 2011 Transportation Economic and Revenue Forecasts*," adopted June 16, 2011. This document provides gas price forecasts up to FY 2027. For the purposes of this study, it is assumed that gas prices keep pace with the inflation assumption of 2.5 percent per year through FY 2017. For the period FY 2018 through FY 2027, the gas price is assumed to grow at a rate such that it matches the State forecast for FY 2027. Beyond FY 2027, the gas price is assumed to increase with inflation rate of 2.5 percent.

Based on the above assumptions, the gas price used in this analysis maintains a constant real price of $3.77 per gallon in 2010 dollars through FY 2017, making the nominal price $4.37 in FY 2017. From FY 2018 through FY 2027, nominal gas prices were assumed to increase at about 0.5 percent per year (well below the assumed inflation rate), increasing to $4.59 in FY 2027 which causes the real price to decline from $3.77 in FY 2017 to $3.09 by FY 2027 in 2010 dollars. Thereafter, nominal gas prices revert back to 2.5 percent inflationary increases, which maintains the real price at $3.09 in 2010 dollars for FY 2027 and onwards.

Sensitivity tests were performed to determine the impact of higher fuel costs as outlined in Chapter 8.

TOLLING ANALYSIS MODEL

MODEL DEVELOPMENT

The PSRC model was used as the initial input for model development purposes. Several refinements were made to the WSA tolling analysis model based on surveys and studies specific to the SR 520 corridor. These surveys and studies included the following:

1. TRAVEL PATTERN SURVEY, INCLUDING ORIGIN-DESTINATION SURVEY

The travel pattern survey results were used to refine the original trip tables so that the origins and destinations of trips using the SR 520 bridge are based on actual usage data. Survey origin and destination data was coded to the model's TAZs. The resulting database was cleaned up and factored to match the observed traffic counts on the bridge. The trip data was then substituted in the original trip tables. For example, the eastbound PM peak period trips from the origin-destination survey were substituted for eastbound PM peak trips in the model. Since the origin-destination survey was conducted eastbound only, eastbound morning (AM) origin-destination survey trips were transposed and substituted for westbound evening (PM) trips. This type of transposition is commonly used for balancing trip data.

A review of trip patterns was performed which indicated consistency at the aggregate level between original and modeled trips. The effects of survey-based adjustments on trip tables were dampened over time so that by the year 2020 no changes were applied. The survey results relating to frequency of roadway use were also used in revenue calculations (see Chapter 2).

2. Stated Preference Survey

The stated preference survey was intended to develop parameters to model people's choice of route with a tolled SR 520 bridge. Information from this survey was used to model trip suppression (i.e. trips cancelled, destinations changed, or combined with other trips), shifts to transit, and changes in trip timing. Information from this survey was also used to determine VOTs for various trip types (see above and Chapter 3).

3. Economic Growth Study

The economic growth study was performed to update or modify the original regional economic forecasts developed by PSRC. The first stage of this work was performed in November 2009 and was updated in December 2010. The main output of this study revised population and employment forecasts taking into account the effects of recent changes in the economy. (See Chapter 4.)

4. Travel Time/Speed Survey

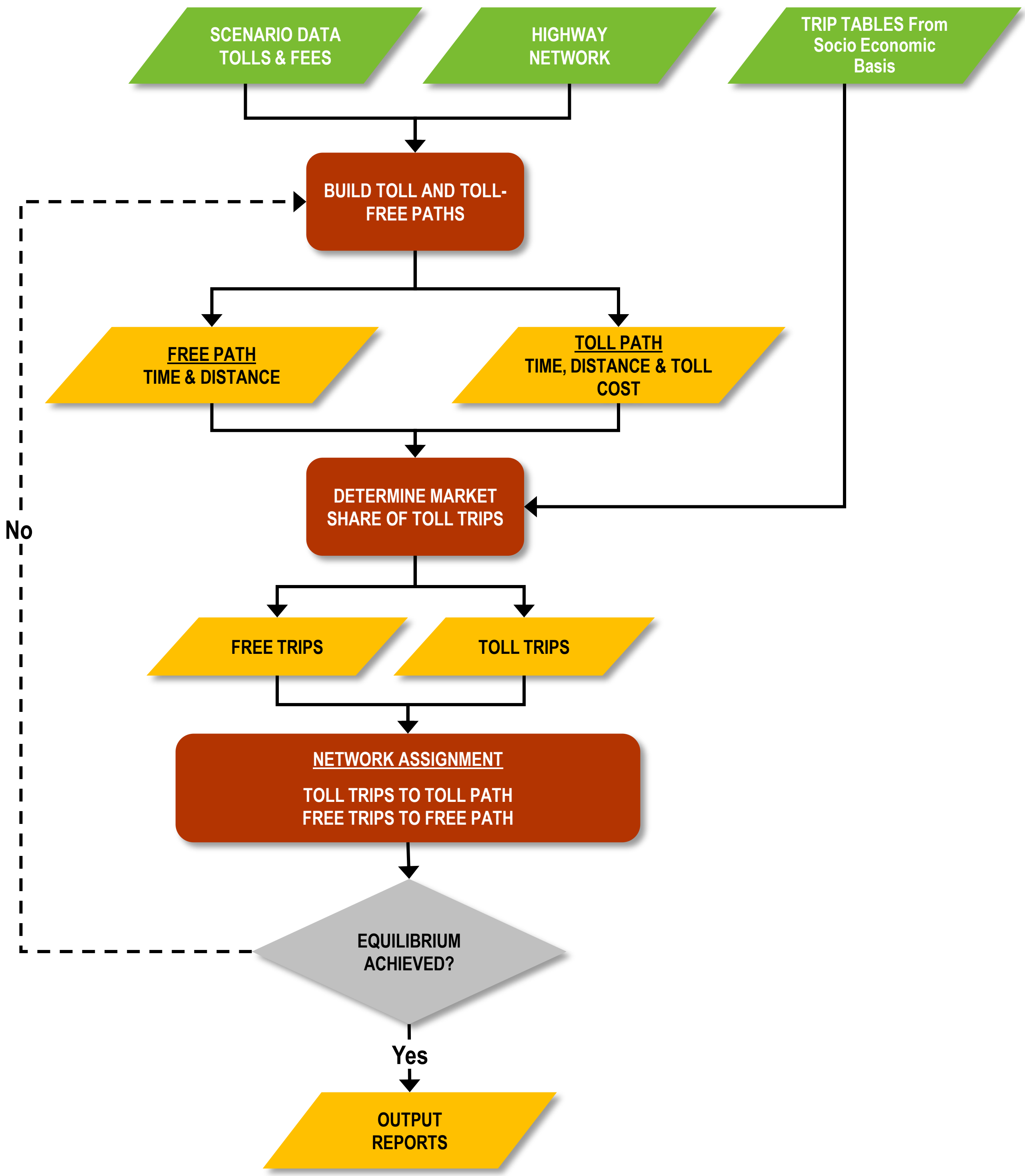
Actual field data on travel times across the bridge, on connecting routes, and on competing routes for major traffic movements was collected and used to calibrate the tolling analysis model.

5. Traffic Counts

Sample traffic count data was collected to supplement the traffic counts data provided by WSDOT. This was used for model calibration purposes.

Model Structure

Figure 6-5 shows the major analytical steps in the toll analysis and modeling process. The main inputs include the trip tables of vehicle trips, the highway network, and information specific to the scenario being studied. The first step in the toll modeling process was to compute travel time and travel costs between each origin-destination zone pair for a tolled and free path. Travel time and cost matrices were developed using a path-building process in the model. Using the time, distance, and toll cost (called skims), a ratio of generalized cost for each path is calculated as follows:



TOLLING ANALYSIS MODEL STRUCTURE

FIGURE 6-5

$$CR = \frac{Toll\ Path\ Cost}{Free\ Path\ Cost}$$

$$CR = \frac{VOT * Tt + OC * Dt + Toll}{VOT * Tf + OC * Df}$$

where,

CR = Cost Ratio
VOT = Value of Time
Tt = Travel Time on Toll Path
Dt = Distance traveled on Toll Path
Tf = Travel Time on Free Path
Df = Distance traveled on Free Path
Toll = Toll Cost
OC = Vehicle Operating Cost

The cost ratio calculated for each movement is then used to split the original trip tables into "toll" and "non-toll" components. The model used for this purpose resembles an S-curve that assumes that if the costs are the same, the trip maker would be indifferent and trips would split evenly between toll and free path share of trips. As the toll path cost increases, the share of tolled trips decreases and more trips are assigned to the free path. However, the resulting congestion on the free path would cause some trips to shift back to the toll path. In each model iteration, the toll trips are assigned to the toll path and non-toll trips to the non-toll path. This process is repeated until a user equilibrium criterion is satisfied, i.e., no further rerouting is possible without user cost degradation. This traffic assignment methodology is referred to as an User Equilibrium Assignment and is generally applied in travel demand models. This methodology inherently takes into account vehicle operating costs for both free and toll paths, including potentially higher vehicle operating costs for using a longer toll-free path.

Information obtained from the assignment process included the number of vehicles using the highway system on the non-toll and toll paths, as well as other performance measures, such as degree of congestion, vehicle miles traveled, and travel time. The number of vehicles assigned to the toll facility was used to determine the revenue and toll sensitivity of the project. The toll sensitivity analysis was conducted by time-of-day for peak, off-peak, and shoulder periods.

MODEL CALIBRATION

ESTIMATED TRAFFIC

Prior to performing the tolling analysis, the travel model was calibrated for 2010 observed weekday traffic levels with emphasis on the SR 520 and I-90 bridges across Lake Washington. The calibration was also performed for the general-purpose and HOV/Express lanes on I-90. Table 6-4 provides a summary of the calibration results.

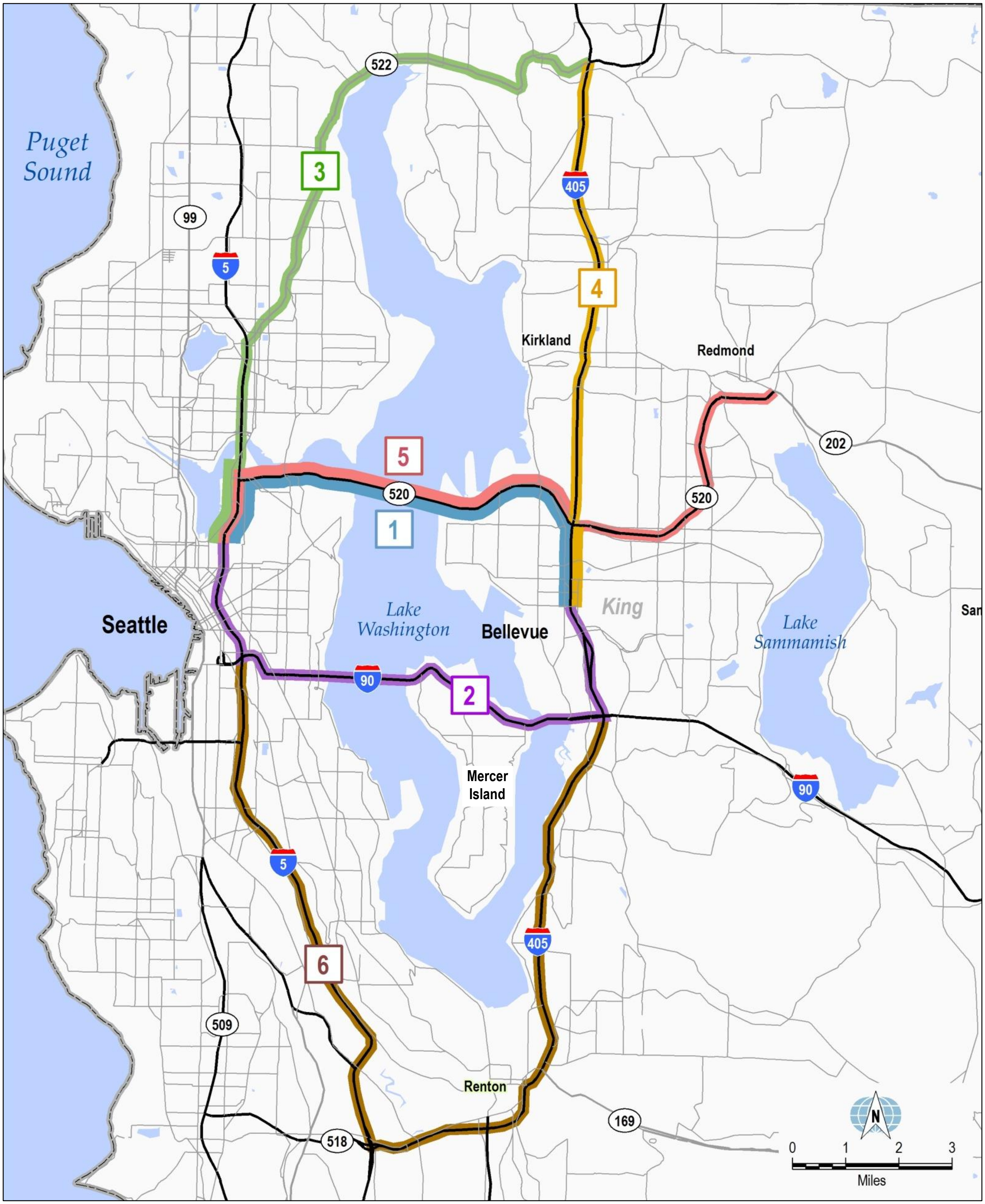
TRAVEL TIME CALIBRATION

WSA performed travel time surveys along the following six routes. The information was used to calibrate the model for travel time.

1. Seattle - Bellevue using SR 520 bridge
2. Seattle - Bellevue using I-90 bridge
3. Seattle - Woodinville using SR 522
4. Bellevue - Woodinville using I-405
5. Seattle - Redmond using SR 520
6. I-5/I-90 to I-405/I-90 using I-5 and I-405 north and south

The above routes are graphically shown in Figure 6-6. The comparison of observed and modeled travel times is provided in Table 6-5.

The calibrated model described above was used to perform toll sensitivity analysis and determination of traffic and revenue as described later in this document.



TRAVEL TIME SURVEY ROUTES

FIGURE 6-6

Table 6-4
Toll-free Model Calibration Summary (2010) for SR 520 and I-90 Bridges Across Lake Washington

Time Period	Route & Direction	Traffic Volume: Observed	Traffic Volume: Model	Traffic Volume: Difference
AM Peak (6am-9am)	SR520 EB	11,448	11,445	0.0%
	SR520 WB	10,265	10,737	4.6%
	I-90 EB GP	13,665	13,635	-0.2%
	I-90 WB GP	14,825	14,504	-2.2%
	I-90 EB HOV	--	--	--
	I-90 WB HOV	3,244	3,334	2.8%
Midday (9am-3pm)	SR520 EB	20,280	20,070	-1.0%
	SR520 WB	18,798	18,974	0.9%
	I-90 EB GP	21,728	22,056	1.5%
	I-90 WB GP	20,647	20,580	-0.3%
	I-90 EB HOV	427	430	0.7%
	I-90 WB HOV	1,920	1,934	0.7%
PM Peak (3pm-6pm)	SR520 EB	10,662	11,052	3.7%
	SR520 WB	10,641	10,899	2.4%
	I-90 EB GP	15,363	15,054	-2.0%
	I-90 WB GP	15,174	14,985	-1.2%
	I-90 EB HOV	3,348	3,546	5.9%
	I-90 WB HOV	--	--	--
Evening (6pm-10pm)	SR520 EB	9,652	9,818	1.7%
	SR520 WB	11,121	11,115	-0.1%
	I-90 EB GP	9,970	9,942	-0.3%
	I-90 WB GP	11,671	11,679	0.1%
	I-90 EB HOV	2,372	2,381	0.4%
	I-90 WB HOV	--	--	--
Night (10pm-6am)	SR520 EB	1,540	1,589	3.2%
	SR520 WB	1,422	1,477	3.9%
	I-90 EB GP	1,396	1,397	0.1%
	I-90 WB GP	1,276	1,261	-1.2%
	I-90 EB HOV	203	202	-0.5%
	I-90 WB HOV	--	--	--

GP is general-purpose lanes
HOV is high occupancy vehicle lanes

Table 6-5
Travel Time Calibration Summary (2010)

			AM Travel Time (Minutes)		PM Travel Time (Minutes)	
Rte.	**Description**	**Dir.**	**Observed**	**Model**	**Observed**	**Model**
1	Seattle - Bellevue using SR 520 Bridge	EB	16.0	16.2	18.0	17.0
		WB	15.0	17.0	18.0	17.0
2	Seattle - Bellevue using I-90 Bridge	EB	13.0	15.9	15.0	17.8
		WB	13.0	16.4	22.0	19.0
3	Seattle - Woodinville using SR 522	NB	28.0	27.2	39.0	36.7
		SB	30.0	33.6	33.0	28.6
4	Bellevue - Woodinville using I-405	NB	10.8	11.0	20.0	20.3
		SB	16.5	17.4	10.2	11.0
5	Seattle - Redmond using SR 520	EB	19.0	20.2	22.5	23.5
		WB	20.2	22.4	21.7	20.8
6	I-5/I-90 to I-405/I-90 using I-5 and I-405	EB	36.5	36.1	31.5	39.6
		WB	36.0	37.4	35.0	38.7

TOLL STRUCTURE

VEHICLE CLASSES

As discussed in Chapter 5, vehicles on the SR 520 bridge will be tolled based on the vehicle class and number of axles. These are:

- 2 Axles – including motorcycles and two-axle – six-tire vehicles
- 3 Axles – including two-axle vehicles towing one-axle trailers
- 4 Axles – any combination of four axles
- 5 Axles – any combination of five axles
- 6 or more Axles – any combination of six or more axles

As noted in Chapter 5, a toll differential between Account-based and Pay-by-Mail tolls will be applied.

The PSRC travel demand model, and consequently the tolling analysis model, categorize vehicles as passenger cars, light trucks, medium trucks, and heavy trucks. Given the axle-based toll schedule, tolls for passenger cars and light trucks (which are two-axle, based on the regional model classification) are assumed to be the adopted two-axle toll rates when calculating toll revenue. For medium and heavy trucks (which have many different axle combinations), a sample SR 520 vehicle axle count from November 2009 was used to determine representative toll rates for trucks by applying a factor. For medium trucks (assumed to be three and four-axle vehicles based on the regional model classification), this factor was 1.59 times the two-axle toll rate. For heavy trucks (five axles or more, based on the regional model classification), the factor was 2.71 times the two-axle toll rate.

TOLL PAYMENT METHODS

As described in Chapter 5, customers will have two ways of paying their toll:

- Account-based, either via transponders or registered license plates linked to a prepaid account
- Pay-by-Mail, in which unregistered video toll users who have a bill mailed to them after using the facility

WSDOT also plans to provide two variations on the payment methods:

- Account-based customers may choose to register their license plate instead of using Good-to-Go! transponders
- Unregistered users who initiate a payment within a specified time period of their tolled trip instead of waiting to receive a bill in the mail

ESTIMATED MARKET SHARE BY PAYMENT TYPES

Initial assumptions of the market share by payment type were developed based on market research conducted by WSDOT and license plate surveys conducted on the SR 520 bridge for sample days. These market share assumptions were used as inputs to traffic and revenue modeling conducted by WSA. The modeling also incorporated toll price differentials between the two payment types. The information on estimated market share by payment types resulting from the toll diversion analysis is presented in Table 6-6 together with the input assumptions.

The latter section of Table 6-6 shows the "output" percentages by payment type following the diversion analysis. These proportions represent the estimated breakdown of users on the tolled SR 520 bridge. The output percentages reflect the difference in total cost to the motorists. Since the potential Pay-by-Mail market faces a higher toll rate (e.g. $1.50 differential for two-axle vehicles), a greater proportion of potential Pay-by-Mail users will divert away from the bridge than those using transponders. Hence, the resulting Account-based shares for all years are higher than the initial assumptions due to the lower toll cost.

Table 6-6
Market Share Percentages by Payment Types

	Model Input Assumptions		
Fiscal Year	**Account-based**	**Pay-by-Mail**	**Total**
2012	62.50%	37.50%	100%
2016	74.00%	26.00%	100%
2017	74.00%	26.00%	100%
2024	80.80%	19.20%	100%
2031	85.00%	15.00%	100%

	Model Output Results		
Fiscal Year	**Account-based**	**Pay-by-Mail**	**Total**
2012	71.76%	28.24%	100%
2016	79.62%	20.38%	100%
2017	79.82%	20.18%	100%
2024	84.69%	15.31%	100%
2031	87.40%	12.60%	100%

TOLL SENSITIVITY

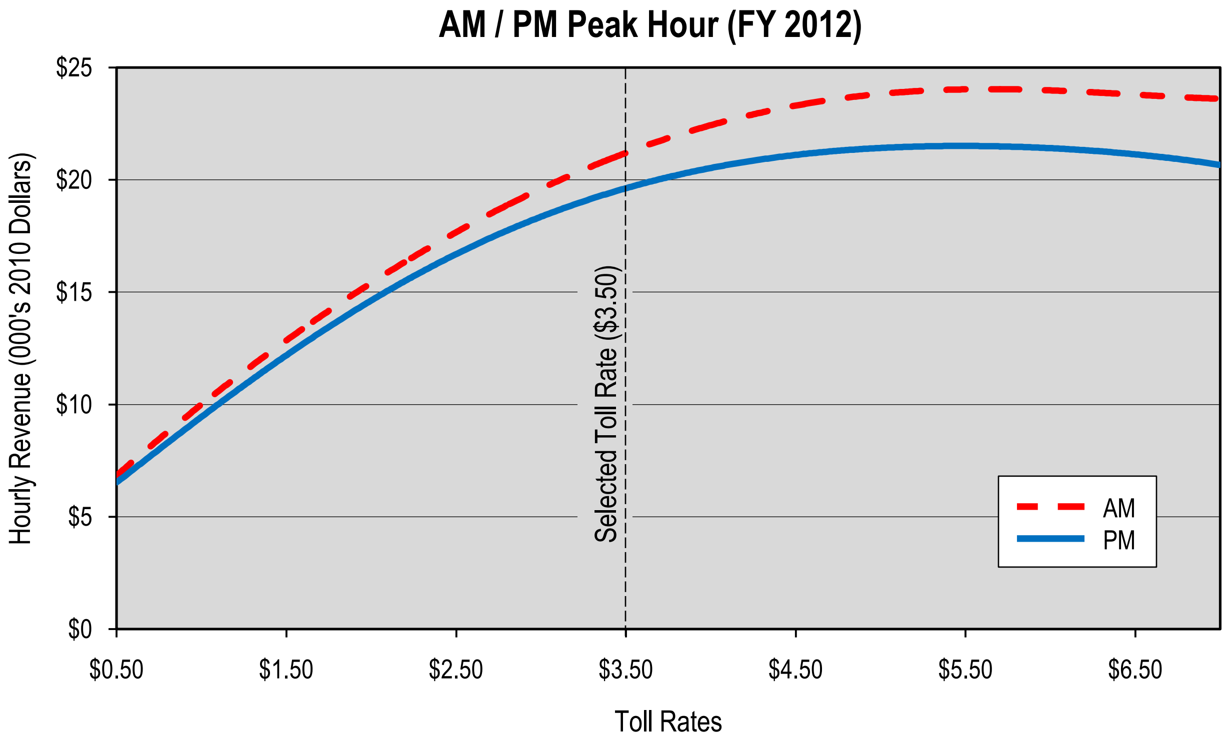
In the project development stage, the travel model described above was applied using a range of toll rates from $0.50 to $6.50 to develop “toll sensitivity” curves for each hour of the day. Toll rate increases result in greater diversions from the SR 520 bridge. Diversion effects include the changes in trip-making decisions such as combining trips, cancelled trips or shifts to transit, as well as the selection of an alternate route. For example, at a $3.50 base toll rate during peak hours: 19 percent of the toll free traffic is estimated to divert to I-90; four percent to SR 522; five percent to I-5/I-405 north or south of the lake; and 15 percent of trips divert to other routes, are not made, shift to transit, or commence at other times of the day. For an off-peak hour with a base toll rate of $2.25, 33 percent of the toll free traffic is estimated to divert to I-90; seven percent to SR 522; five percent to I-5/I-405 north and south of the lake; and eight percent of trips divert to other routes, are not made, or shift to transit.

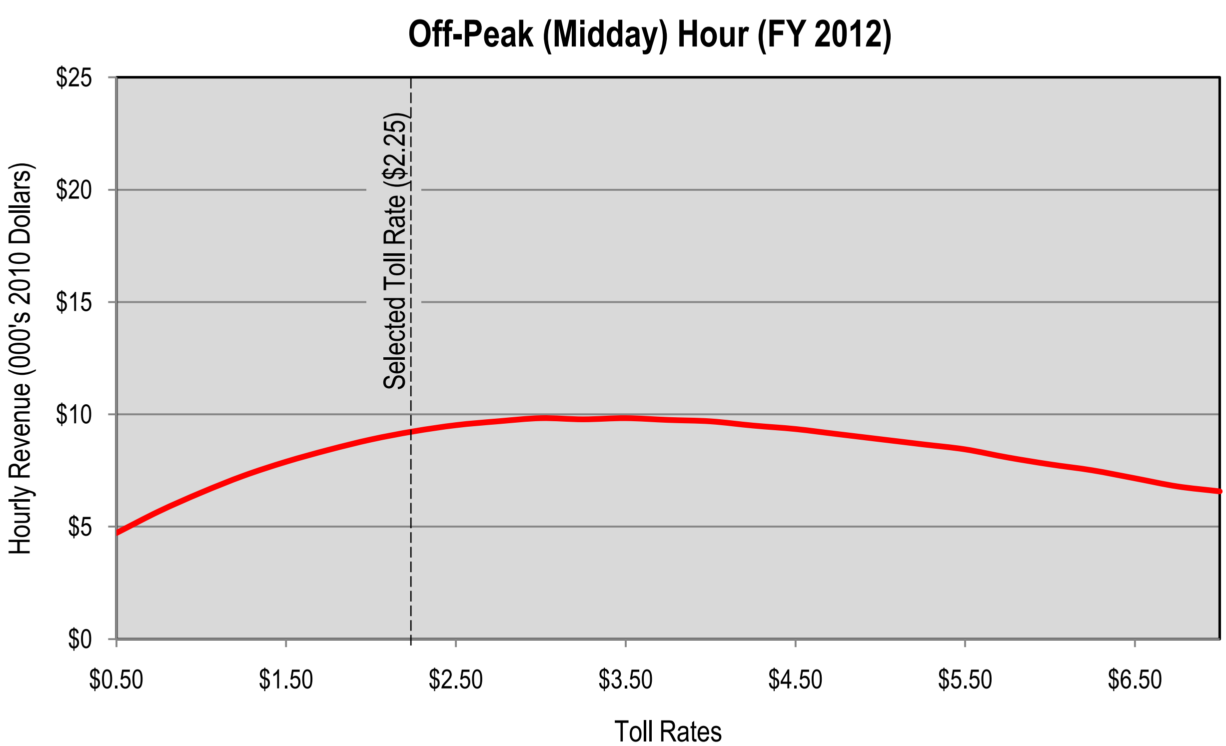
The range of toll rates was modeled in $0.50 increments and the corresponding revenue was computed and plotted as a graph. Figure 6-7 shows the results of this analysis for typical AM and PM peak hours and off-peak hours for FY 2012. Figure 6-8 shows toll sensitivity curves for FY 2017. Both figures also indicate where the selected toll rates fall on the sensitivity curve. It is generally noted that at lower toll rates, as the rate increases, transactions decrease but revenue increases. At a certain toll rate, the decrease in transactions outweighs the higher toll rate, and revenue begins to decline.

TOLL RATES

The results of the toll sensitivity analysis and prior studies by WSDOT were used to develop several sets of toll rates. Several tolling schemes were tested and the revenue potential of each was estimated. The final FY 2012 toll rates for the SR 520 bridge were selected by the Washington State Transportation Commission (WSTC) in November 2010 and formally adopted in January 2011. The WSTC also reviewed a financing plan which assumed 2.5 percent average toll rate increases at the beginning of each fiscal year from FY 2013 through FY 2016, a 15 percent weekday and 2.5 percent weekend average increase beginning FY 2017, and no toll increases from FY 2018 onward. Figures 6-9, 6-10, and 6-11 show the toll rates assumed for FY 2012, FY 2017, and FY 2031 respectively based on the Commission's adopted toll rates for FY 2012 and the financial plan assumed increases. These toll rates were used for the purpose of this study and form the basis of the revenue estimates.

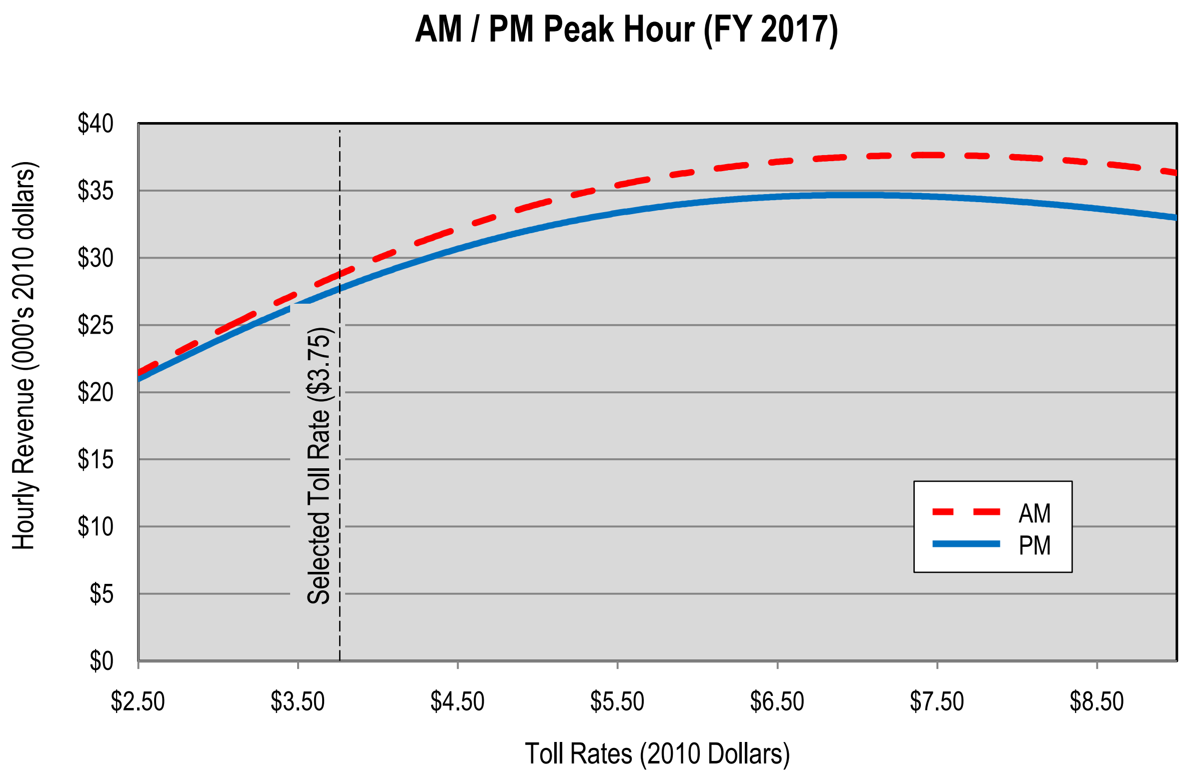
Figures 6-7 and 6-8 illustrate the selected toll rates for peak and off-peak times with respect to the toll sensitivity curves. Revenue maximization is achieved at toll rates corresponding to the crest of the revenue curve. As indicated on the figure, the selected toll rates are lower than the maximizing revenue toll rates. In FY 2012, revenue maximization would occur at a rate of $5.25 in both the AM and PM peak periods, and at $3.50 during the off-peak (midday). The FY 2012 selected $3.50 peak period toll rate is estimated to generate revenue equal to 88 percent of the maximum revenue during the AM peak period. The selected $3.50 peak period toll rate is estimated to generate 91 percent of the maximum revenue during the PM peak periods. During the off-peak (midday) in FY 2012, the selected toll rate of $2.25 is estimated to generate 94 percent of the maximum revenue. In FY 2017, revenue maximization would occur at a rate of $7.00 in both the AM and PM peak periods, and at $4.00 during the off-peak (midday). The FY 2017 selected peak period toll rate of $3.75 during the peak periods is estimated to generate 80 and 76 percent of the maximum revenue

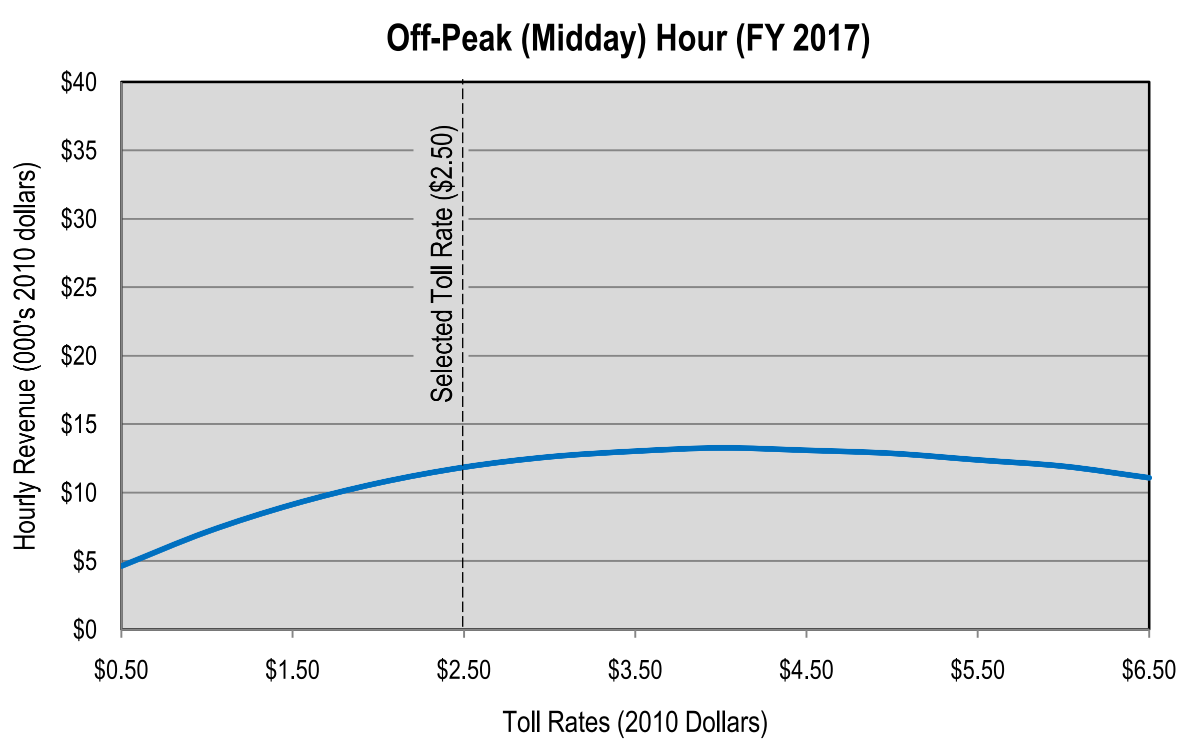




TOLL SENSITIVITY CURVES FY 2012

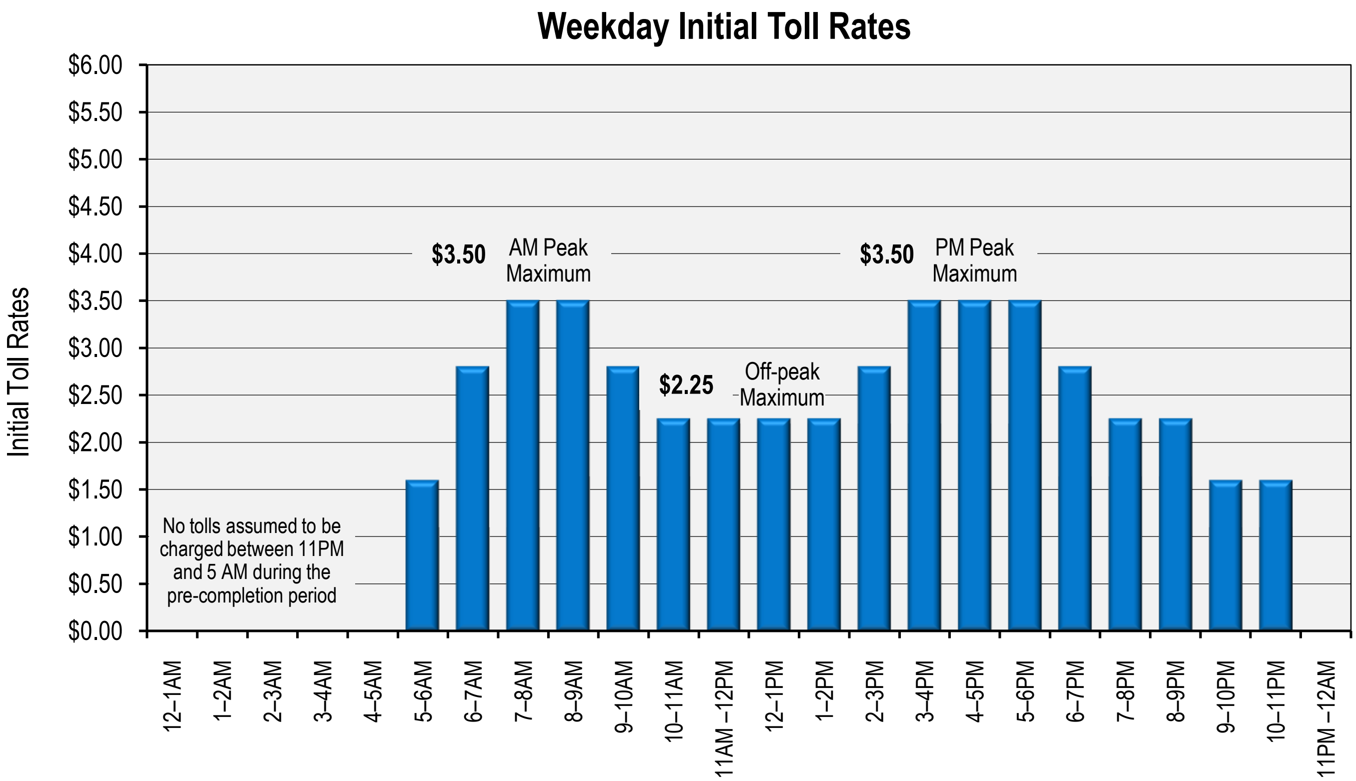
FIGURE 6-7

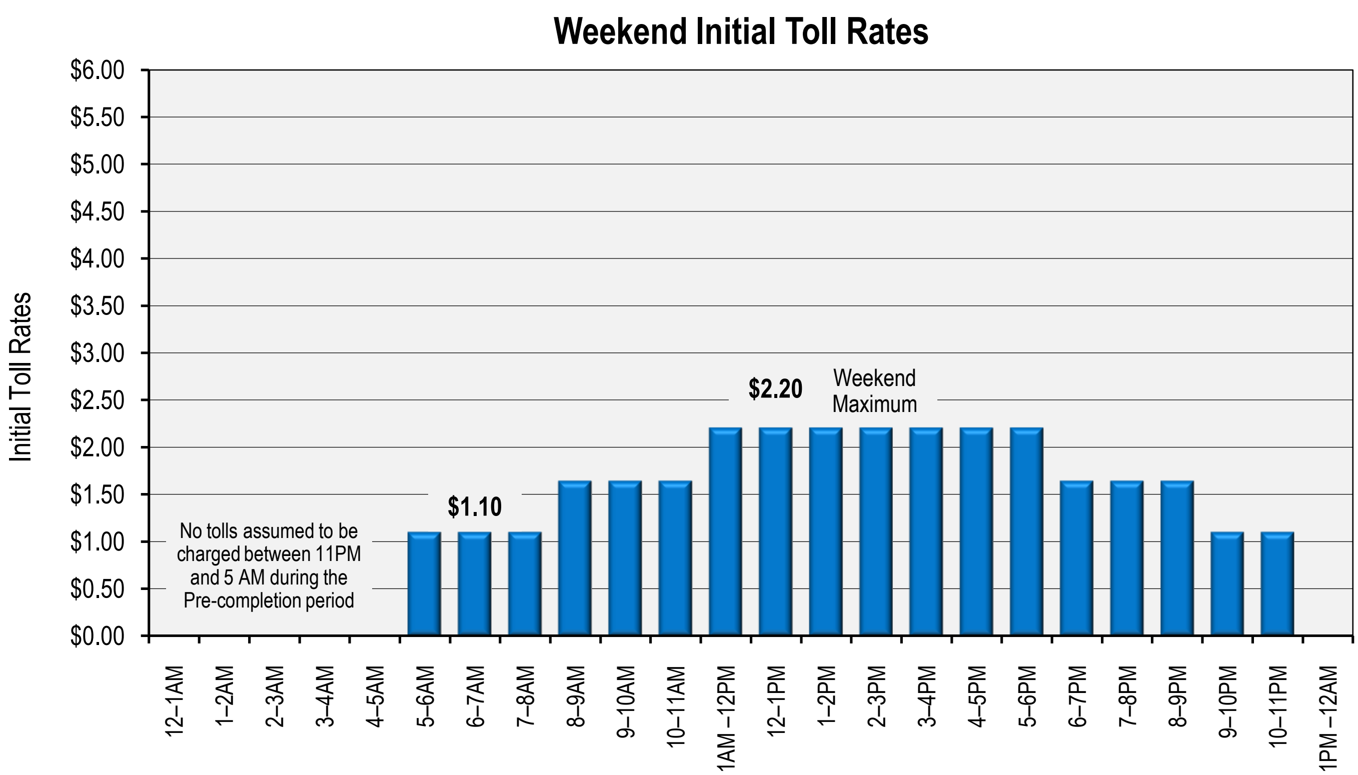




TOLL SENSITIVITY CURVES FY 2017

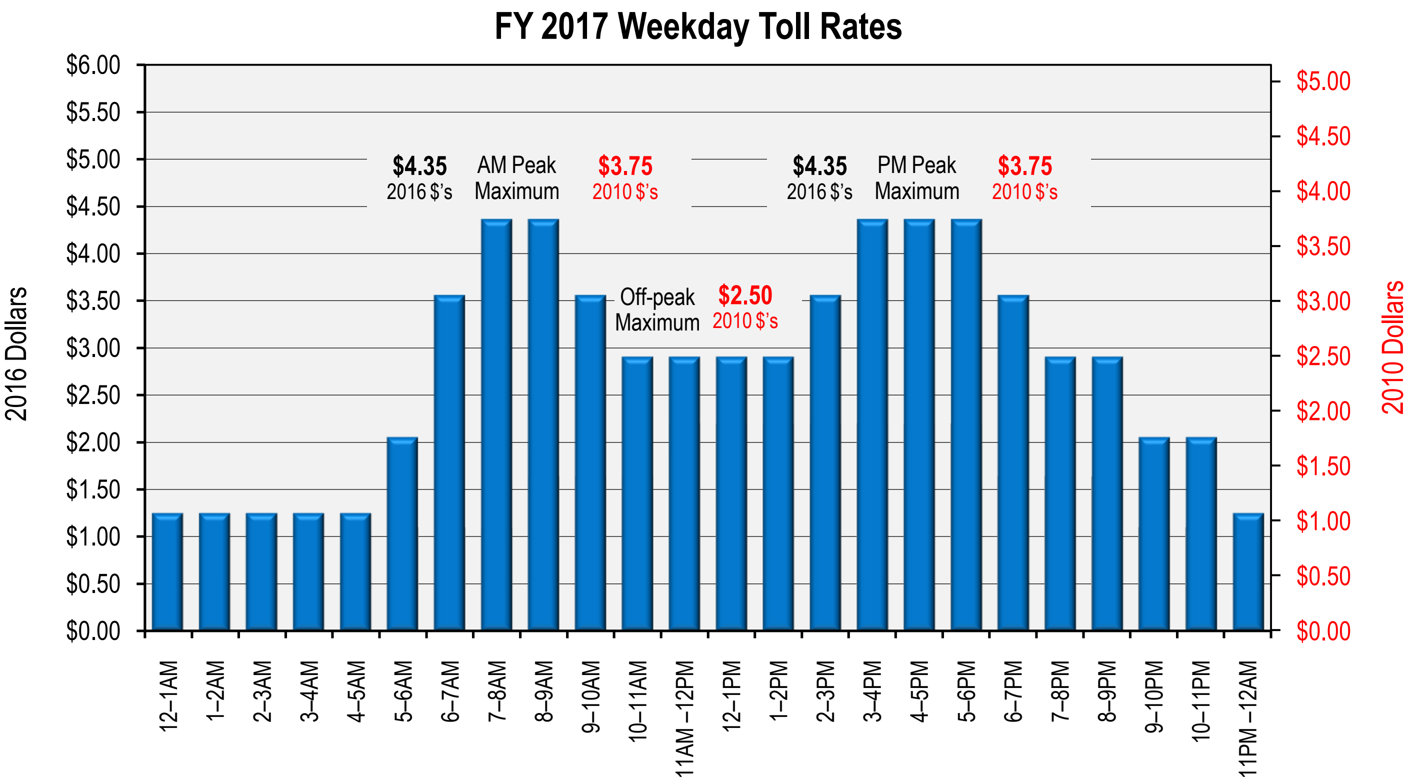
FIGURE 6-8

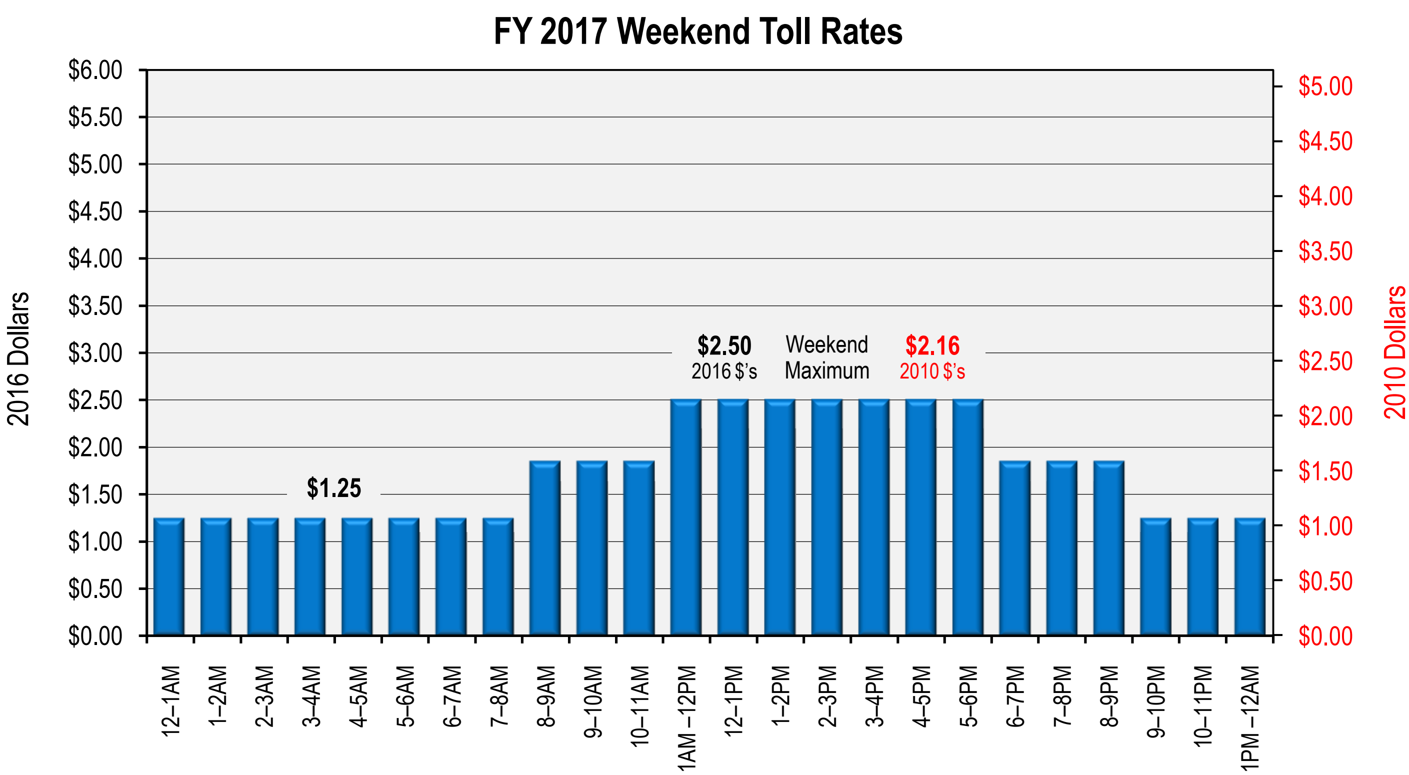




INITIAL (FY 2012) TOLL RATES ON EXISTING SR 520 BRIDGE

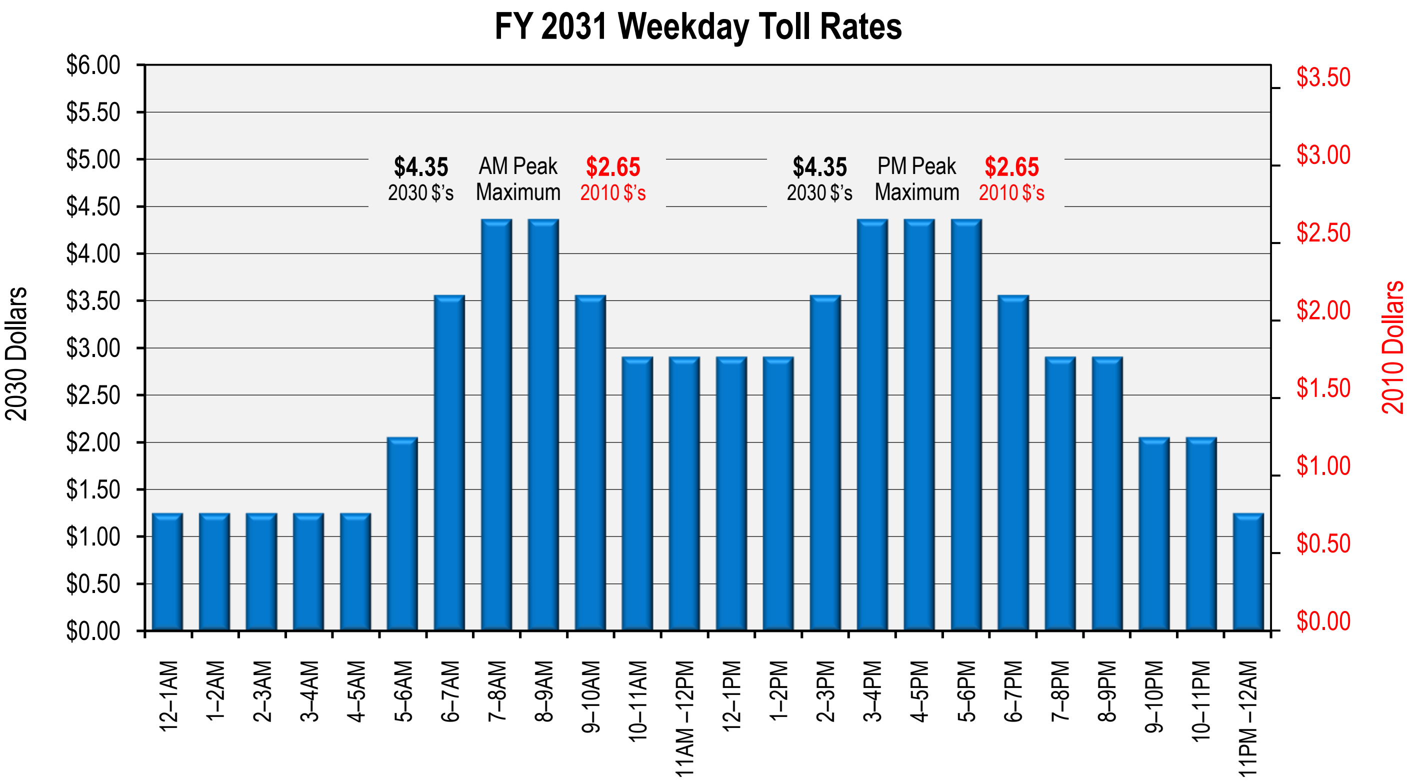
FIGURE 6-9

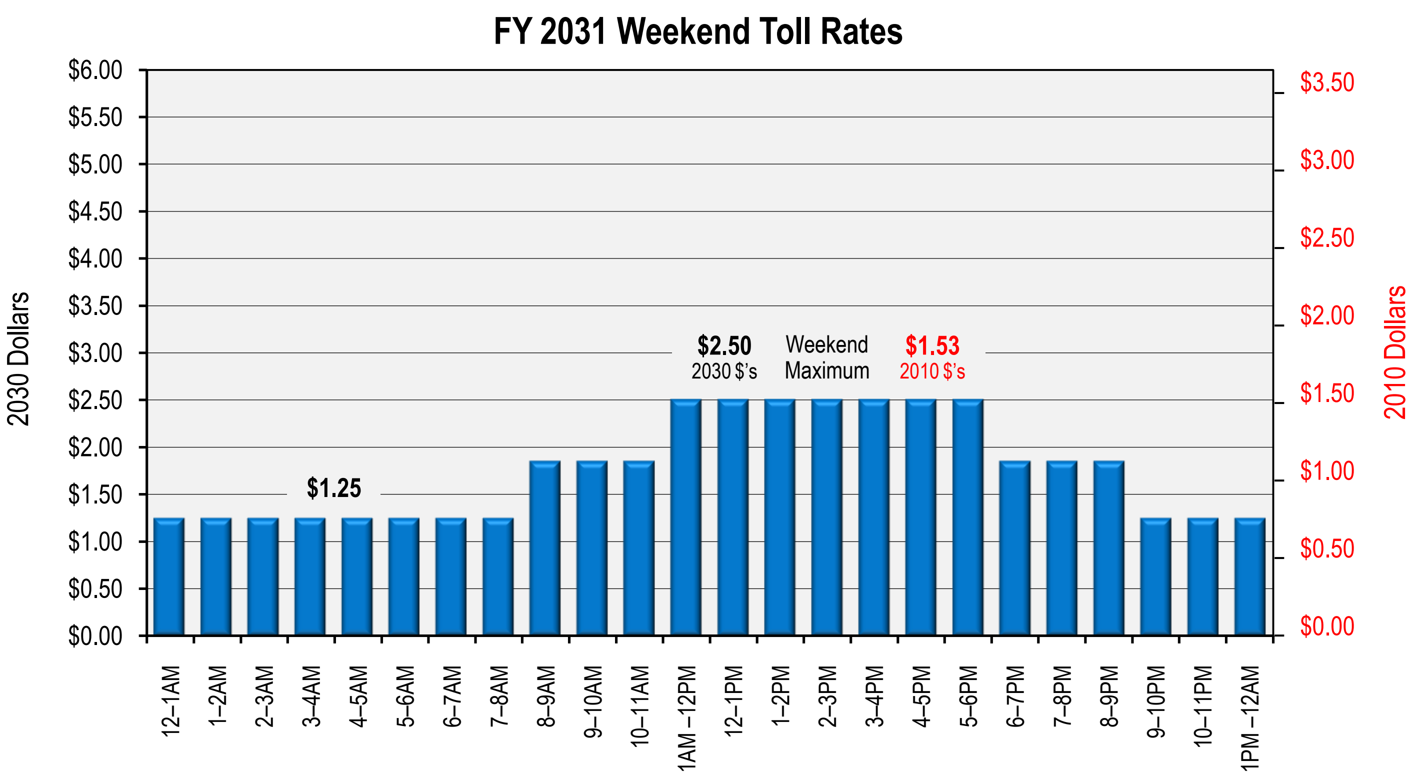




FY 2017 TOLL RATES ON NEW SR 520 BRIDGE

FIGURE 6-10





FY 2031 TOLL RATES ON SR 520 BRIDGE

FIGURE 6-11

during the AM and PM peak periods, respectively. During the off-peak (midday) in FY 2017, the selected toll rate of $2.50 is estimated to generate 89 percent of the maximum revenue (all FY 2017 toll rates mentioned above are in 2010 dollars).

MAJOR ASSUMPTIONS

Table 6-7 summarizes the major assumptions that form the basis of the forecasts presented in this document. These assumptions are divided into categories as indicated in the following table:

Table 6-7
Major Assumptions

Category	Assumptions
General Assumptions	Improvements in the Puget Sound Regional Council's current regional transportation plan, *Transportation 2040* , will be implemented as planned. No new competitive toll-free facilities or additional capacity will be constructed during the projection period other than those assumed in the plan.
	The percentage of payment types will be consistent with the ranges assumed for this study. The percentage of potential bridge users in the Account-based program is assumed to increase from 62.5 percent in FY 2012 to 85 percent in FY 2031.
	Economic growth in the project study area will occur as forecasted herein based in part on forecasts from the Puget Sound Regional Council and the September 2010 Conway Pederson forecasts.
	The facility will be well maintained, efficiently operated, effectively signed, and promoted to encourage maximum usage.
	Inflation will average 2.5 percent per year.
	Motor fuel will remain in adequate supply and no national or regional emergency will arise that would abnormally restrict the use of motor vehicles. The per-gallon price for passenger car fuel is assumed at $3.86 in FY 2012. Through FY 2027 it is assumed to increase in accordance with the June 2011 WSDOT Transportation Economic and Revenue Forecasts report and by 2.5 percent thereafter.
	The value of time for work trips ranges from $9.60 per hour for the lowest income group to $22.80 per hour for the highest income group. The value of time for non-work passenger car trips is $13.80 per hour. Truck trip value of time reaches $36.00 per hour for heavy trucks. All values are in 2010 dollars.
Bridge Configuration	FY 2012 - FY 2016: Two narrow general-purpose lanes and shoulders in each direction.
	FY 2017 and onward: Two wider general-purpose lanes in each direction, one HOV/transit lane (with three person occupancy requirement HOV3+) in each direction, and wider shoulders in each direction on the new span. This configuration will connect back to the existing two general-purpose lanes in each direction west of the new western high-rise.
SR 520 Configuration East of Bridge to I-405	FY 2012 - FY 2016: Two general-purpose lanes in each direction and one outside HOV lane (with three person occupancy requirement HOV3+) westbound as exists currently.
	FY 2017 and onward: Two general-purpose lanes in each direction and one inside HOV/transit lane in each direction (with three person occupancy requirement HOV3+).

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Table 6-7 (Continued from previous page)

Toll Collection	Tolls will be collected at a single point on the eastern high-rise of the main span while traffic remains on the existing bridge and at a single point on the eastern shore when traffic moves to the new bridge.
	Toll rates will be the same for either direction on the bridge.
	The toll collection is all electronic; there will be no manual toll collection.
	FY 2012 - FY 2016: no night time tolling (11pm - 5am).
	FY 2017 and beyond: tolls will be charged during all 24 hours.
Toll Rates	**FY 2012 - FY 2016**
	Tolling commences on January 1, 2012.
	The maximum initial Account-based toll rate for two-axle vehicles will be $3.50 on weekdays and $2.20 on weekends.
	At the beginning of FY 2013 and for each subsequent year through FY 2016 (i.e., on July 1 of 2012, 2013, 2014, and 2015) both weekday and weekend Account-based tolls will increase by 2.5 percent on average.
	In FY 2012, Pay-by-Mail customers will pay a $1.50 differential above the Account-based toll rates. At the beginning of each subsequent fiscal year (FY 2013 through FY 2016), the differential for Pay-by-Mail customers will escalate by 2.5 percent.
	High occupancy vehicles (HOVs) will pay the same toll as single-occupant vehicles (SOVs).
	Toll exemptions as outlined by the Washington State Transportation Commission (the largest of which is the transit buses, private regular route buses such as the Microsoft Connector, and WSDOT sanctioned vanpools) are assumed.
	Tolls for multi-axle vehicles (those with more than two axles on the ground) will be determined by multiplying the number of axles by the per-axle toll rate for two-axle vehicles using the same payment method. Consequently, in FY 2012, Pay-by-Mail customers will be paying a $0.75 per-axle differential above the Account-based toll rates.
	FY 2017 and beyond
	Weekday Account-based tolls will increase on average approximately 15 percent from FY 2016 to FY 2017 (i.e., on July 1, 2016).
	Weekend Account-based tolls will increase approximately 2.5 percent on average from FY 2016 to FY 2017 (i.e., on July 1, 2016).
	The Pay-by-Mail toll differential will increase 2.5 percent from FY 2016 to FY 2017 (i.e., on July 1, 2016).
	Toll exemptions as noted above are continued.
	HOVs with three or more occupants will be exempt from paying tolls; HOVs with two occupants will pay the same toll as SOVs.
	Tolls for multi-axle vehicles will be based on the number of axles as noted above.
	No toll rate escalation is assumed after FY 2017.
Construction Closures	Full weekend closure of SR 520 from the Montlake Interchange to I-405 including the tolled section will occur four times in the last half of FY 2012, five times in FY 2013, four times in FY 2014, and two times in FY 2015. Closure will be from 11 PM on Friday to 5 AM on Monday.
Ramp-Up	Annualized traffic was adjusted downwards to 95% to reflect ramp-up in FY 2012 and to 97% in FY 2013 to take into account possible initial resistance to tolling a facility that has been free since 1979.

CHAPTER 7

TRAFFIC & GROSS REVENUE

This chapter provides the results of the baseline estimates of traffic and gross revenue for this project. Estimates were made from the assumed start of tolling on January 1, 2012 (the beginning of the third quarter of Fiscal Year (FY) 2012) through June 30, 2057 (the end of FY 2056). Estimates were made for an average weekday using the methodology and toll rate structure described in Chapter 6. Estimates were then annualized taking into account weekend traffic and toll rates. This chapter describes this process and presents the results.

The analysis summarized in this report is intended for use in financing the State Route 520 (SR 520) bridge project. In this traffic and revenue estimation process, it is incumbent on the State to make prudent assumptions that will not overstate revenue receipts. Because of this goal, traffic forecasts in this evaluation are lower than what are used for the SR 520 bridge replacement National Environmental Policy Act (NEPA) process and those used in operational planning purposes. However, a strict comparison cannot be made because of differences in underlying assumptions. For the NEPA environmental studies, the project team must make assumptions that will not understate traffic and its impact on the environment. Traffic volumes in this report are solely used for the purposes of estimating an appropriate level of revenue and are not intended to act as replacements for the I-5 to Medina NEPA analysis results.

ESTIMATED DAILY TRAFFIC & REVENUE

WEEKDAY TRAFFIC

The analysis described in the previous chapter was applied to estimate daily weekday toll traffic. The years that actual traffic assignments were performed were used to directly develop estimates for FY 2012, FY 2016, FY 2017, FY 2024, FY 2031, and FY 2056. Both FY 2016 and FY 2017 were directly modeled because the bridge lane configuration is assumed to change during that time. Estimates for years between FY 2012 and FY 2016, FY 2017 and FY 2024, and FY 2024 and FY 2031 were developed by interpolation. The method to estimate the post FY 2031 years is described later in this chapter.

A primary effect of tolling SR 520 is that motorists will divert to other routes to avoid paying the toll. Chapter 6 has a detailed description of diversion. In addition to traffic diversions, Wilbur Smith Associates (WSA) anticipates there will be further reduction in travel due to a variety of factors such as changes in destination choice, combining trips, or simply reduced trip frequencies. For this project this has been estimated in the range of three to four percent in addition to the significant estimates of traffic diversions to alternative routes. This is somewhat lower than what had been anticipated and what was actually experienced on Tacoma Narrows Bridge. Trip suppression on that facility when tolls were reintroduced was closer to six percent. However, the Tacoma Narrows Bridge had very few, if any, viable alternatives and diverted traffic as a result of tolling was quite minimal. Opportunities to avoid the tolls on Tacoma Narrows were limited to reducing trip making or changing destinations. There are other opportunities to avoid the tolls on SR 520 as evidenced by the substantially higher estimates of traffic diversions to alternatives routes.

It is estimated that in FY 2012 the tolling of SR 520 will result in mode shifts to transit, causing about 3,400 additional transit trips per weekday across the bridge. Currently there are about 16,000 transit trips per weekday across the bridge. The seat capacity on cross-bridge transit is about 36,000 so the additional trips are absorbable. By FY 2017 the number of additional transit trips is estimated to rise to about 4,225 which is still within current transit capacity.

Table 7-1 provides a summary of the estimated weekday traffic volumes for the key years. Between FY 2012 and FY 2016 traffic volumes increase because of anticipated post-recession growth and an anticipated increased participation in the Account-based payment program by potential users. Any growth in overall traffic will have a substantial impact on the tolled SR 520 bridge as there is very little available capacity on alternative routes. As those alternate routes get congested the incentive to pay the toll and use the SR 520 bridge becomes greater. Also, toll rates are lower for registered users; for passenger cars toll rates are $1.50 less. Thus, by increasing levels of registered accounts more potential users will experience the lower toll rate resulting in less diversion and more bridge usage.

The estimated volumes will change from FY 2016 to FY 2017 as a result of several factors. Traffic is assumed to use the fully-completed new bridge in FY 2017 which has additional capacity and operational advantages over the old bridge. This factor has a positive effect on usage. The approximately 15 percent increase in toll rates in FY 2017 has a downward effect on toll traffic from FY 2016 to FY 2017. Not tolling vehicles with three or more occupants (HOV3+ traffic) beginning in FY 2017 also reduces toll traffic volumes from FY 2016 to FY 2017 but increases non-tolled traffic. The beginning of nighttime tolling in FY 2017 increases tolled traffic but reduces non-tolled traffic. The net effect of these factors is a small reduction in usage between FY 2016 and FY 2017.

Table 7-1
Estimated Weekday Vehicular Traffic on SR 520

	Tolled Passenger Cars		Tolled Trucks				
Fiscal Year	Account-based	Pay-by-Mail	Account-based	Pay-by-Mail	Total Tolled	Non-Tolled	Total Traffic
2012	40,215	15,697	1,976	857	58,745	4,208	62,953
2016	57,463	14,626	3,497	974	76,561	4,752	81,313
2017	54,096	13,591	3,519	974	72,181	4,865	77,046
2024	69,785	12,557	5,114	985	88,441	5,751	94,192
2031	83,088	11,928	7,037	1,063	103,116	6,647	109,763

Note:
Account-based refers to transactions linked to a Good to Go! account
Pay-by-Mail refers to transactions where unregistered users are mailed a toll invoice
The adopted weekday toll schedule includes an approximately 15 percent increase from FY 2016 to FY 2017
The above numbers are not adjusted for ramp-up effects
The above traffic volumes are intended to be used for revenue estimates only

After FY 2017, toll rates are not increased. Thus with inflation the real value of tolls decreases post FY 2017, which has a positive effect on bridge traffic volumes. Also, small increases in regional growth, as described in Chapter 4, contribute to increased toll usage. This growth has the direct effect of increasing the demand for the bridge and the indirect positive effect on bridge usage by increasing congestion on possible alternates to the SR 520 bridge reducing diversions.

WEEKDAY REVENUE

Toll revenue estimates presented are gross revenue; the revenue that would result if each vehicle passing through the toll collection point paid exactly the published toll rate based on the vehicle's classification, time of day, and toll payment method. The gross revenue shown does not include the effects of overpayments, underpayments, uncollectible tolls, or toll evasion. No analysis of these toll variance factors is included in this report. Toll variance factors are considered in the "SR 520 Bridge Net Toll Revenue Report."

The toll transactions for a weekday were used in conjunction with the corresponding toll rates to calculate the average weekday toll revenue. The weekday revenue was adjusted further for the effects of peak spreading on the basis of information from the stated preference survey. Typically, the peak spreading resulted in shifting some component of trips from peak hours to shoulder hours with lower toll rates. The peak spreading reduced the total weekday revenue by approximately 2.5 percent, which makes the resulting estimates more conservative. The estimated revenue for a weekday in year of collection dollars is provided in Table 7-2.

Table 7-2
Estimated Weekday Revenue on SR 520 in Year of Collection Dollars

	Passenger Cars		Trucks		
Fiscal Year	Account-based	Pay-by-Mail	Account-based	Pay-by-Mail	Weekday Revenue
2012	$ 112,915	$ 68,474	$ 11,203	$ 7,468	$ 200,060
2016	175,802	69,347	21,040	9,006	275,196
2017	185,949	70,155	24,035	9,882	290,022
2024	231,134	63,059	34,092	9,790	338,075
2031	275,442	60,026	46,945	10,608	393,021

Note:
Account-based refers to transactions linked to a Good to Go! account
Pay-by-Mail refers to transactions where unregistered users are mailed a toll invoice
The adopted weekday toll schedule includes an approximately 15 percent increase from FY 2016 to FY 2017
The above numbers are not adjusted for ramp-up effects

ESTIMATED ANNUAL TRAFFIC & GROSS REVENUE

ANNUALIZATION METHOD

The information from existing weekend traffic profiles and the weekday analysis were used to estimate weekend tolled traffic on SR 520 as there was not enough information to apply the travel demand model for weekends. The first step in this process was to review the weekend hourly traffic profile and determine the relationship between weekday and weekend demand. For various times of the day on weekends, weekday hours with matching traffic levels were identified. The diversion information from weekday results was then applied to weekend hours with generally similar traffic levels. For hours with similar traffic levels, toll rates for weekends are typically lower than weekdays. Toll diversion information from higher weekday toll rates was applied to equivalent weekend traffic which is subjected to lower weekend toll rates. This results in a somewhat conservative approach to estimating weekend toll revenue.

For each modeled year the daily weekday traffic and revenue and the derived weekend traffic and revenue estimates were used as input to calculate the annual traffic and revenue. First, the average weekday traffic was adjusted to an average non-holiday weekday traffic. Then daily traffic was extrapolated to a full year. The annual estimates were further adjusted for six major holidays. It was assumed that if a major holiday falls on a weekday, it will be treated as a weekend day with the weekend toll rates applied. The actual number of such weekdays was determined for the financing period and a factor was determined and applied to adjust the traffic and revenue numbers. Other weekday holidays such as Veteran's Day and Martin Luther King Day assumed weekday toll rates. The effect of leap years was also considered in this process and a factor was applied to adjust the traffic and revenue numbers.

The annual traffic and revenue estimates were made for the key years of FY 2012, FY 2016, FY 2017, FY 2024, and FY 2031. Intermediate year results were derived by interpolation. For the growth and extrapolation of traffic estimates from FY 2031 to FY 2041, socioeconomic growth was assumed to taper down until it reached no growth for FY 2041 and beyond. The traffic levels in FY 2056 were determined by applying the FY 2031 socioeconomic conditions and highway system with FY 2056 toll levels using the travel model based assignment process. As this study assumes no toll escalation beyond FY 2017, the toll rates were therefore assumed to be decreasing in real dollars beyond FY 2017. This extrapolation approach for years beyond FY 2031 ensured that the system capacity is used as a constraint in the determination of long term forecasts and with the assumption of no socioeconomic growth beyond FY 2041 the approach can be considered to be on the conservative side.

RAMP-UP

The annualized traffic and revenue were further adjusted to reflect "ramp-up". Ramp-up is a phenomenon that is often applied to forecasts for new facilities that may experience a high rate of growth in the first few years to reach the full forecast level as people become familiar with the facility. In the case of most new facilities, ramp-up duration is about five years with the start-up year near 80 percent. In case of SR 520, this adjustment is intended to reflect an initial negative reaction to paying a toll on a route previously not tolled before a better understanding of the benefit of using the tolled facility prevails. Since this is an existing facility, the issue of "finding out" that there is a new route, does not exist. For this reason, the ramp-up adjustments were shorter in duration and more aggressive as shown in Table 7-3.

Table 7-3
Ramp-up Values for SR 520

Fiscal Year	Ramp-up
2012	95.0%
2013	97.0%
2014+	100.0%

CONSTRUCTION IMPACTS

Since the replacement bridge is being constructed as a completely new structure to the north of the existing bridge, construction impacts are assumed to be minimal based on a review of the proposed construction process. There will be some full weekend closures of SR 520 from Montlake Boulevard to I-405 including the tolled section during construction. The weekend closures are assumed to begin at 11:00 pm Friday and end at 5:00 am Monday. All closures are assumed to happen in both directions of travel. Based on a closure schedule, it is assumed that four closures will happen in FY 2012, five in FY 2013, four in FY 2014, and two in FY 2015. The transactions and revenue estimates for these years were reduced to reflect the impacts of these closures.

RESULTS

Table 7-4 presents the annual transactions and gross toll revenue for the key model years. The revenue is expressed in terms of year of collection dollars. Note that for FY 2012 the estimates are for six months only as tolling was assumed to start on January 1, 2012.

Table 7-4
Estimated Annual Toll Transactions & Revenue on SR 520
(in millions)

Fiscal Year	Annual Transactions	Annual Revenue
2012	8.66	$ 27.84
2016	23.96	$ 81.92
2017	23.62	$ 87.64
2024	29.62	$ 104.21
2031	34.12	$ 120.15
2056	40.27	$ 140.38

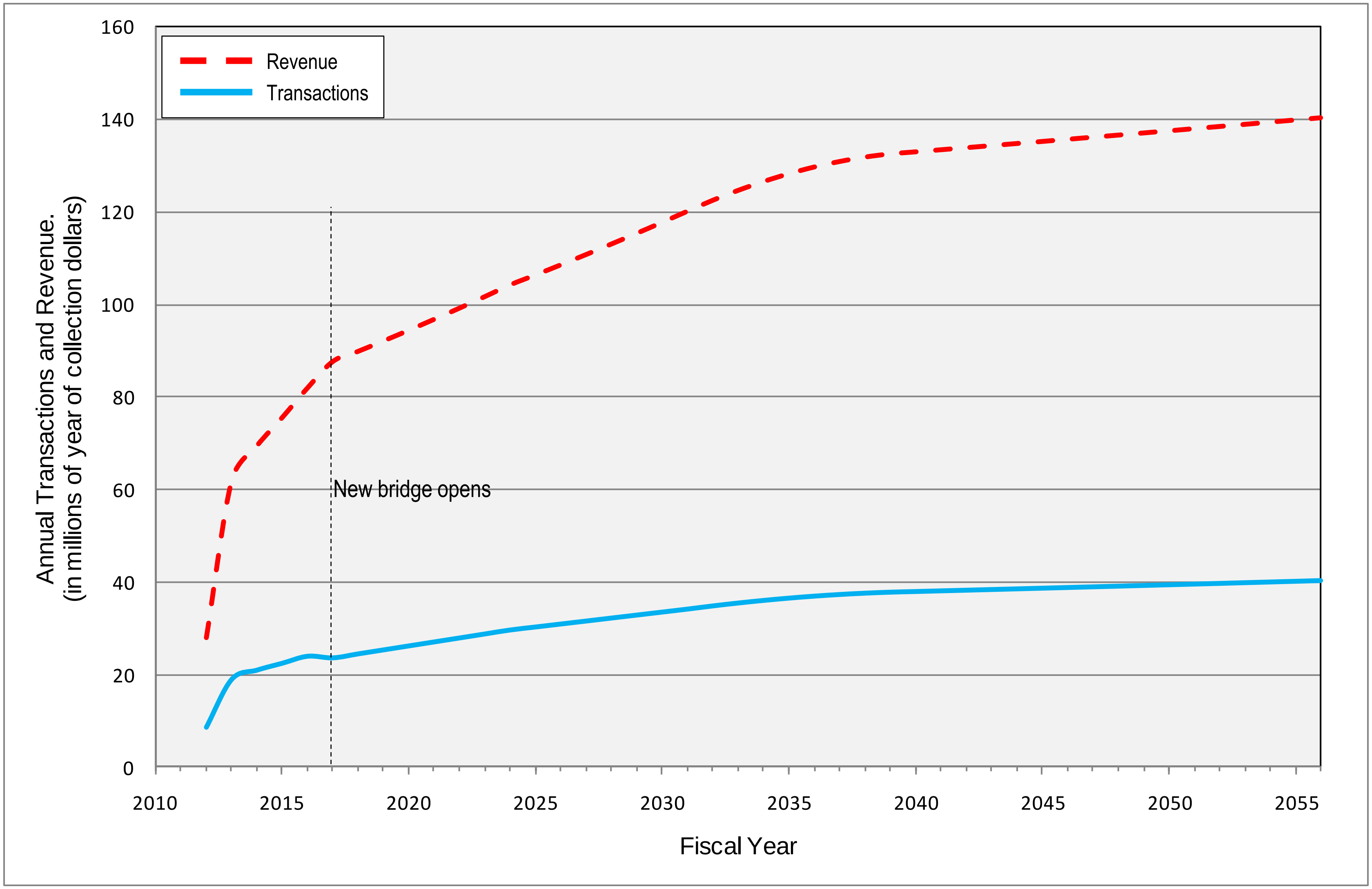
Note:
Revenue estimates are in year of collection dollars
The above traffic volumes are intended to be used for revenue estimates only
FY2012 numbers are adjusted for ramp-up effects and for six months only

Table 7-5 provides a summary of estimated transactions forecasts by fiscal year for the financing period. The corresponding estimated gross revenue stream is provided in Table 7-6. Figure 7-1 provides the transactions and revenue streams as a graph.

The above-mentioned gross revenue results are all in year of collection dollars. These estimates, as mentioned at the beginning of this chapter, do not include toll collection leakage and evasion effects.

Excluding the ramp-up and construction impacts and annualizing the FY 2012 results to a full year, the forecasts from FY 2012 through FY 2016 indicate a 6.7 percent increase in transactions and 8.5 percent increase in revenue per year. The transactions will grow in part because forecasted post-recession recovery will increase demand which will have a compound effect on SR 520 usage. There will be slightly more trips crossing the lake. More importantly, overall congestion in the system will increase making travel to and along alternative routes less attractive. Participation in the Good to Go! registered account program is increasing which will result in more potential users basing their usage decision on a lower toll. The revenue is increasing slightly faster than transactions as it benefits from the 2.5 percent annual increase in toll rates but also is being held down by the increasing number of users in the Account-based program paying less money per transaction.

In FY 2017 there is an assumed one-time increase in toll rates of about 15 percent. Overnight tolling is assumed to start at this time. Prior to FY 2017



WilburSmith ASSOCIATES

PROJECTED TOLL TRANSACTIONS AND GROSS REVENUE

FIGURE 7-1

Table 7-5
Projected Toll Transactions (in millions) on SR 520 (FY 2012-2056)

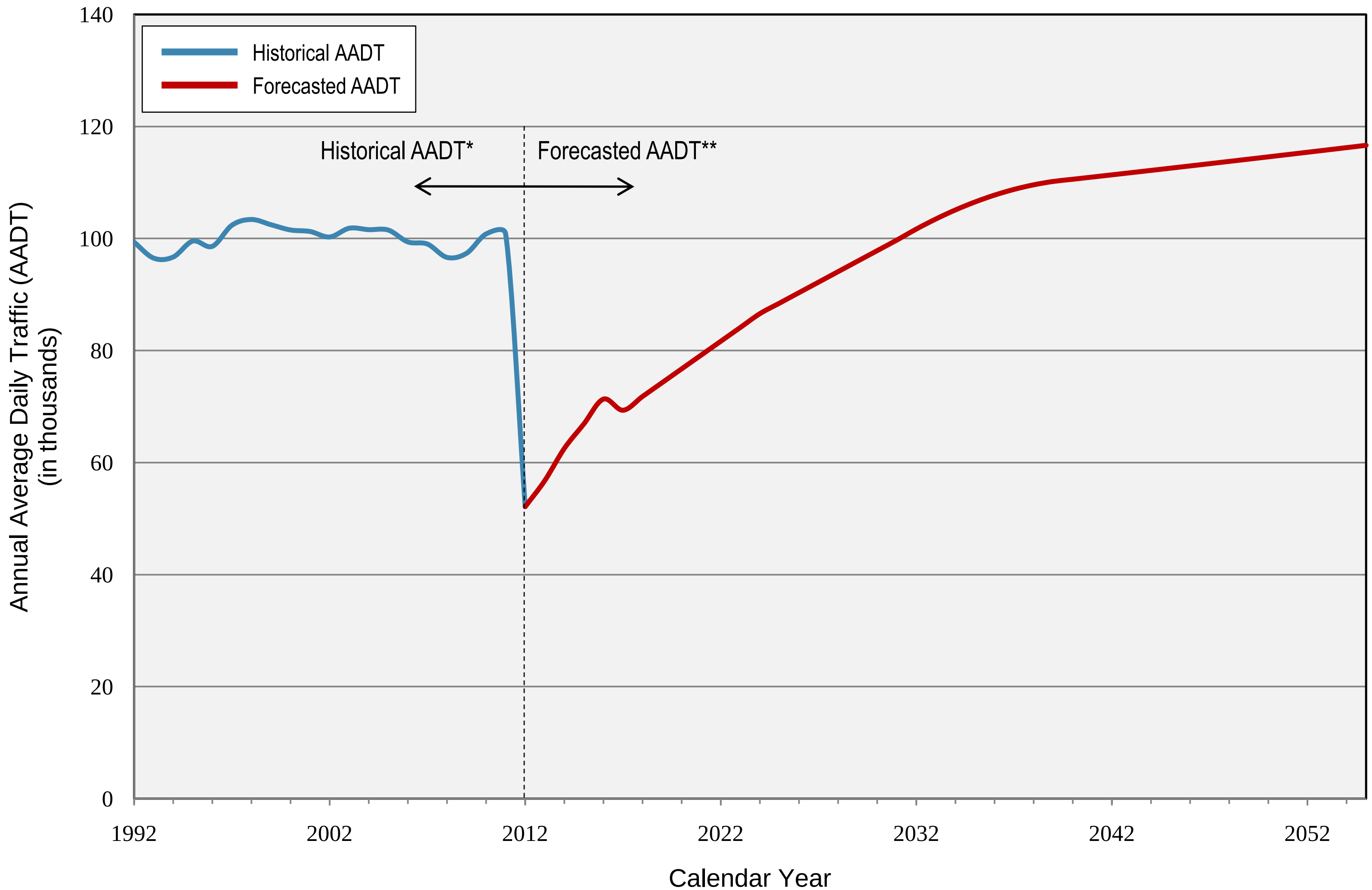
	Passenger Car			Truck				
Fiscal Year	Account-based	Pay-by-Mail	Total	Account-based	Pay-by-Mail	Total	Total Transactions	Growth %
2012	5.923	2.321	8.244	0.291	0.124	0.415	8.659	
2013	13.358	4.647	18.005	0.707	0.261	0.968	18.973	
2014	15.128	4.712	19.840	0.849	0.279	1.128	20.968	10.5%
2015	16.545	4.647	21.192	0.973	0.290	1.263	22.455	7.1%
2016	17.980	4.581	22.561	1.098	0.301	1.399	23.960	6.7%
2017	17.695	4.451	22.146	1.157	0.315	1.472	23.618	-1.4%
2018	18.505	4.416	22.922	1.237	0.316	1.553	24.475	3.6%
2019	19.316	4.382	23.698	1.317	0.318	1.635	25.333	3.5%
2020	20.126	4.347	24.474	1.397	0.319	1.716	26.190	3.4%
2021	20.937	4.313	25.249	1.477	0.322	1.799	27.048	3.3%
2022	21.747	4.278	26.025	1.557	0.323	1.880	27.905	3.2%
2023	22.558	4.244	26.801	1.637	0.325	1.962	28.763	3.1%
2024	23.368	4.209	27.577	1.717	0.326	2.043	29.620	3.0%
2025	23.957	4.172	28.129	1.805	0.329	2.134	30.263	2.2%
2026	24.546	4.135	28.681	1.892	0.333	2.225	30.906	2.1%
2027	25.135	4.098	29.233	1.980	0.336	2.316	31.549	2.1%
2028	25.724	4.061	29.785	2.068	0.339	2.407	32.192	2.0%
2029	26.313	4.024	30.337	2.156	0.342	2.498	32.835	2.0%
2030	26.902	3.987	30.889	2.243	0.346	2.589	33.478	2.0%
2031	27.491	3.950	31.441	2.331	0.349	2.680	34.121	1.9%
2032	28.034	4.045	32.079	2.369	0.356	2.725	34.804	2.0%
2033	28.528	4.134	32.662	2.403	0.363	2.765	35.427	1.8%
2034	28.971	4.215	33.187	2.432	0.368	2.799	35.986	1.6%
2035	29.362	4.289	33.651	2.457	0.373	2.830	36.481	1.4%
2036	29.698	4.355	34.054	2.477	0.377	2.853	36.907	1.2%
2037	29.978	4.414	34.392	2.492	0.380	2.872	37.264	1.0%
2038	30.201	4.465	34.665	2.502	0.384	2.886	37.551	0.8%
2039	30.365	4.507	34.872	2.508	0.385	2.893	37.765	0.6%
2040	30.471	4.541	35.012	2.508	0.387	2.895	37.907	0.4%
2041	30.577	4.576	35.153	2.509	0.388	2.896	38.049	0.4%
2042	30.684	4.610	35.294	2.509	0.389	2.898	38.192	0.4%
2043	30.791	4.645	35.437	2.509	0.390	2.899	38.336	0.4%
2044	30.899	4.681	35.579	2.509	0.391	2.901	38.480	0.4%
2045	31.007	4.716	35.723	2.510	0.392	2.902	38.625	0.4%
2046	31.115	4.752	35.867	2.510	0.394	2.904	38.771	0.4%
2047	31.224	4.788	36.012	2.510	0.396	2.906	38.918	0.4%
2048	31.333	4.825	36.158	2.510	0.396	2.906	39.064	0.4%
2049	31.443	4.861	36.304	2.510	0.399	2.909	39.213	0.4%
2050	31.553	4.898	36.451	2.510	0.400	2.910	39.361	0.4%
2051	31.663	4.936	36.599	2.510	0.400	2.910	39.509	0.4%
2052	31.774	4.973	36.747	2.510	0.401	2.912	39.659	0.4%
2053	31.885	5.011	36.897	2.510	0.403	2.913	39.810	0.4%
2054	31.997	5.050	37.047	2.510	0.404	2.914	39.961	0.4%
2055	32.109	5.088	37.197	2.510	0.406	2.916	40.113	0.4%
2056	32.221	5.127	37.349	2.510	0.406	2.916	40.265	0.4%

Notes:
Tolling is assumed to start on January 1, 2012. FY 2012 numbers are for 6 months only.
Ramp-up is assumed at 95 percent for FY 2012, 97 percent for FY 2013, and 100 percent in FY 2014 and beyond.
Account-based refers to transactions by electronic transponder or license plate linked to a prepaid Good To Go! account.
Pay-by-Mail refers to transactions where unregistered users are mailed a toll invoice.
The above traffic volumes are intended to be used for revenue estimates only.

Table 7-6
Projected Toll Revenue (in millions of year of collection dollars) on SR 520 (FY 2012-2056)

	Passenger Car			Truck				
Fiscal Year	Account-based	Pay-by-Mail	Total	Account-based	Pay-by-Mail	Total	Total Gross Revenue	Gross Revenue Growth %
2012	$ 15.582	$ 9.716	$ 25.298	$ 1.536	$ 1.006	$ 2.542	$ 27.840	
2013	35.970	19.888	55.858	3.792	2.160	5.952	61.810	
2014	41.760	20.644	62.404	4.637	2.349	6.986	69.390	12.3%
2015	46.772	20.831	67.603	5.415	2.492	7.907	75.510	8.8%
2016	52.045	21.010	73.055	6.234	2.631	8.865	81.920	8.5%
2017	55.746	21.756	77.502	7.202	2.936	10.138	87.640	7.0%
2018	57.702	21.581	79.283	7.608	2.939	10.547	89.830	2.5%
2019	59.721	21.385	81.106	8.029	2.945	10.974	92.080	2.5%
2020	61.804	21.165	82.969	8.467	2.954	11.421	94.390	2.5%
2021	63.955	20.920	84.875	8.922	2.963	11.885	96.760	2.5%
2022	66.174	20.650	86.824	9.395	2.961	12.356	99.180	2.5%
2023	68.464	20.354	88.818	9.885	2.967	12.852	101.670	2.5%
2024	70.828	20.030	90.858	10.394	2.958	13.352	104.210	2.5%
2025	72.552	19.927	92.479	10.886	2.995	13.881	106.360	2.1%
2026	74.318	19.807	94.125	11.396	3.029	14.425	108.550	2.1%
2027	76.128	19.668	95.796	11.925	3.059	14.984	110.780	2.1%
2028	77.981	19.509	97.490	12.473	3.097	15.570	113.060	2.1%
2029	79.879	19.331	99.210	13.041	3.129	16.170	115.380	2.1%
2030	81.823	19.131	100.954	13.630	3.156	16.786	117.740	2.0%
2031	83.815	18.910	102.725	14.240	3.185	17.425	120.150	2.0%
2032	85.385	19.217	104.602	14.513	3.405	17.918	122.520	2.0%
2033	86.856	19.632	106.488	14.709	3.463	18.172	124.660	1.7%
2034	88.172	20.013	108.185	14.879	3.506	18.385	126.570	1.5%
2035	89.326	20.358	109.684	15.020	3.556	18.576	128.260	1.3%
2036	90.313	20.668	110.981	15.133	3.596	18.729	129.710	1.1%
2037	91.128	20.939	112.067	15.217	3.616	18.833	130.900	0.9%
2038	91.769	21.173	112.942	15.270	3.648	18.918	131.860	0.7%
2039	92.233	21.368	113.601	15.292	3.667	18.959	132.560	0.5%
2040	92.519	21.524	114.043	15.284	3.673	18.957	133.000	0.3%
2041	92.806	21.681	114.487	15.276	3.687	18.963	133.450	0.3%
2042	93.093	21.840	114.933	15.267	3.700	18.967	133.900	0.3%
2043	93.382	21.999	115.381	15.259	3.710	18.969	134.350	0.3%
2044	93.672	22.160	115.832	15.250	3.718	18.968	134.800	0.3%
2045	93.962	22.322	116.284	15.241	3.725	18.966	135.250	0.3%
2046	94.254	22.486	116.740	15.231	3.739	18.970	135.710	0.3%
2047	94.547	22.651	117.198	15.222	3.750	18.972	136.170	0.3%
2048	94.840	22.817	117.657	15.212	3.751	18.963	136.620	0.3%
2049	95.135	22.984	118.119	15.202	3.769	18.971	137.090	0.3%
2050	95.430	23.153	118.583	15.192	3.775	18.967	137.550	0.3%
2051	95.727	23.323	119.050	15.182	3.788	18.970	138.020	0.3%
2052	96.024	23.494	119.518	15.172	3.800	18.972	138.490	0.3%
2053	96.323	23.667	119.990	15.161	3.799	18.960	138.950	0.3%
2054	96.623	23.841	120.464	15.150	3.816	18.966	139.430	0.3%
2055	96.923	24.016	120.939	15.139	3.822	18.961	139.900	0.3%
2056	97.225	24.193	121.418	15.128	3.834	18.962	140.380	0.3%

Notes:
Tolling is assumed to start on January 1, 2012. FY 2012 numbers are for 6 months only.
Ramp-up is assumed at 95 percent for FY 2012, 97 percent for FY 2013, and 100 percent in FY 2014 and beyond.
Account-based refers to transactions by electronic transponder or license plate linked to a prepaid Good To Go! account.
Pay-by-Mail refers to transactions where unregistered users are mailed a toll invoice.



* Historical AADT: WSDOT Annual Traffic Data Reports
** Forecast AADT: T&R Analysis

HISTORICAL AND FORECASTED SR 520 ANNUAL AVERAGE DAILY TRAFFIC

FIGURE 7-2

the bridge is not assumed to be tolled between 11:00 pm to 5:00 am. Also, vehicles with three or more occupants (HOV3+) are allowed to use new special lanes without paying tolls.

From FY 2017 till FY 2031, no further toll increases are assumed and the average annual rate of transactions and revenue increase is 2.7 percent and 2.2 percent, respectively. As there are no toll rate changes beyond FY 2017, the dollar value of tolls in real dollars decreases with inflation assumed to be 2.5 percent per year. This effect along with regional growth in traffic results in a modest but steady annual growth in transactions and revenue. Note that regional growth in traffic contributes to increased toll bridge usage directly by increasing the number of potential users; and indirectly by increasing congestion levels on alternate routes making using the toll bridge more attractive. Also, the revenue growth lags the transaction growth primarily because additional usage occurs at a higher rate during off-peak periods when revenue per transaction is lower than peak periods.

Beyond FY 2031 through the end of forecast period, these annual growth rates decrease further to 0.7 percent and 0.6 percent for transactions and revenue, respectively. Small socioeconomic growth is conservatively assumed between FY 2031 and FY 2041 with no growth after FY 2041. Thus, the traffic and revenue growth rate seen in this period is low and almost all the result of the decreasing cost of the toll rate in real dollars.

ADDITIONAL NOTES ON RESULTS

Near and long-term traffic growth on the tolled SR 520 bridge is forecasted. This is in contrast to the relatively flat traffic levels in the recent past. Figure 7-2 shows historical and forecasted annual average daily traffic on SR 520. This result is expected for a number of reasons:

- Traffic under the existing toll-free operating condition on SR 520 reached nominal capacity several years ago. The facility has little or no room for additional growth in most peak periods, and capacity constraints have limited growth over the last decade.
- Current traffic levels continue to be additionally suppressed by the effect of the "great recession" and fluctuation in gasoline prices over the last two to three years. The underlying socioeconomic forecasts assume recession recovery growth through 2017, which is expected to result in traffic increases beyond historical rates.
- The traffic diversion impacts associated with the imposition of tolling will be at their worst soon following the commencement of tolling. Traffic is estimated to drop 48 percent immediately after tolling begins. In future years, as congestion levels on all facilities continue to increase, the competitive position of the SR 520 bridge will gradually improve.
- The re-establishment of tolling on SR 520 is expected to result in significant diversions of traffic to I-90 and other alternative routes. This creates a large amount of new capacity for growth on SR 520 which was not present on the existing bridge for the last decade.
- The improved facility will increase the effective capacity of the crossing after 2017. In addition to the additional HOV lane in each direction, lane widths and shoulder width improvements will increase the effective operating capacity of the two general-purpose lanes in each direction.
- Only inflationary toll increases are planned from FY 2012 through FY 2016. Only one toll increase beyond these inflation increases is programmed in FY 2017, upon assumed completion of the project. Even with nominal inflation, the effective toll rates will decrease over time throughout the remainder of the forecast period. As a result, the implicit diversion potential to alternative facilities will decrease over time, further contributing to the higher level of sustained growth.

These and other factors are expected to result in a level of annual traffic growth which would be higher in the future under a tolled condition than has been experienced in the last five to ten years under a heavily constrained toll-free condition.

CHAPTER 8

SENSITIVITY TESTS

This chapter includes the results of a series of tests conducted to measure the sensitivity of revenue forecasts to changes in key study assumptions. The assumptions chosen for the tests are those that present risks because they are subject to variability and have a potential impact on the magnitude of the revenue estimate. The sensitivity tests were conducted for fiscal year (FY) 2012, FY 2017, FY 2024, and FY 2031. Each parameter was tested individually. The following sensitivity tests were performed:

- Regional growth
- Value of time
- Account-based participation rate
- Motor fuel costs
- Trip suppression and mode shift
- Possible tolling of the I-90 bridge

The first four of the tests above are commonly used in investment grade studies. Trip suppression is included in this study because Lake Washington is a substantial physical barrier to travel. The testing of the effect of tolling I-90 is unique to this study. The sensitivity tests were performed independently of each other and as such, the results are not necessarily additive and do not provide an estimate of the overall impact of changes if they were to occur simultaneously.

Table 8-1 provides the sensitivity test results in table form and Figure 8-1 provides the results graphically. Table 8-1 and Figure 8-1 are placed at the end of this chapter. Details of the tests and a discussion of the results are provided in the following section.

SENSITIVITY TESTS ASSUMPTIONS AND RESULTS

REGIONAL GROWTH

This sensitivity test quantified the possible variation in traffic and revenue from variations in the socioeconomic forecast used in the toll modeling process. In this study, the base forecasts were obtained from Puget Sound Regional Council (PSRC). Forecasts were then modified by an independent economist and used in the traffic model. The sensitivity test included testing a No Growth scenario as one lower side test. This scenario assumed no growth in the region beyond what is there today. This represents an extremely pessimistic case for a region that historically has grown. As a less extreme case a low-growth scenario test was performed. This scenario assumed the incremental growth in the region will be only 50 percent of the growth assumed in the baseline forecast. A higher side test was also included. This test assumed the increment of growth would be 50 percent greater than the baseline forecast. The results of these tests are shown in Table 8-1 labeled as No Growth, Low Growth, and High Growth.

These tests indicate that the long-term revenue potential on State Route 520 (SR 520) is not heavily dependent on future economic growth in the region. While some economic growth is certainly anticipated, this growth accounts for a relatively small share of future revenue.

For example, the No Growth test involved the assumption that there will be no economic growth in the Puget Sound region for at least the next two decades. This is an unlikely scenario, but provides a good indication of the extent to which future revenues are dependent on future economic growth. The results of this test showed that revenue would be reduced by less than 30 percent, even in the year 2031, if there were no economic growth. This suggests that less than 30 percent of the future revenue potential, even 20 years after the commencement of tolling, is directly attributable to economic growth.

From the standpoint of revenue risk, this is a very positive indication. In general, economic growth forecasts are one of the most significant areas of uncertainty in the traffic and revenue forecasting process. In general, the higher the dependence on future economic growth, the higher the long-term risk to the forecast. In this case, since the facility has such a strong, well-established pattern of existing usage, we find that it is much less dependent than most other new toll facilities on future economic growth, which inherently reduces the magnitude of risk associated with this important factor.

Similarly, Wilbur Smith Associates (WSA) tested the impacts of a 50 percent increase or a 50 percent decrease in the amount of growth going forward from FY 2012. A 50 percent reduction in growth over the next 20 years would reduce toll revenues by less than 14 percent. The reduced growth scenario represents a condition which is not likely, but not inconceivable. This relatively low risk on long-term revenues is a strong consideration for the project.

A 50 percent increase in the growth beyond that currently anticipated would have an 18 percent positive impact by FY 2031, with lower impacts in the earlier years.

VALUE OF TIME

The value of time (VOT) test quantified the revenue impact of the VOT varying from what was used in the study. The VOT is important to the revenue forecast but can be difficult to quantify. The test evaluated VOTs 20 percent lower and higher than the VOT used in the baseline analysis. The 20 percent variation is somewhat arbitrary but is consistent with other studies.

The results are shown in Table 8-1 labeled “20% Higher VOT” and “20% Lower VOT.” FY 2012 presents the biggest difference compared to the baseline scenario. With time, the forecast effect of lower or higher VOT continues to decline. For instance, a 20 percent lower value of time in FY 2012 causes an 11.2 percent decrease in revenue. This declines to a 3.4 percent decrease in revenue by FY 2031. Two factors affect the trend over time. (Note, motorists’ routing decisions include travel time, vehicle operating costs, and toll costs, if any.) First, since it is assumed there will be no toll increases after FY 2017, toll rates decrease in real dollar terms with time, making the cost of the toll a smaller factor in the routing decision versus total travel time. Second, the network congestion increase over time increases the total travel time factor in the routing decision. Consequently, both effects trend together in the same direction to make the impact of VOT changes smaller over time.

ACCOUNT-BASED PARTICIPATION RATE

This test examined the difference between traffic and revenue of Account-based transaction participation rates differing from those assumed in the baseline scenario. The baseline scenario assumes that in FY 2012, 62.5 percent of the potential SR 520 bridge users participate in the Account-based system through either a transponder or pre-registering their license plate. The high and low sensitivity tests evaluate a change of plus and minus 20 percent (i.e., 75 and 50 percent) of the potential users utilizing the Account-based system. For FY 2017 the baseline was 74 percent and the high and low tests were 89 and 59, respectively. For 2024 the baseline was 80.8 percent and the high and low tests were 97.0 and 64.6 percent, respectively. For 2031 the baseline was 85 percent and the high and low tests were 100 and 68 percent, respectively.

The results of the test are shown in Table 8-1 labeled as “20% Higher Account-based” and “20% Lower Account-based.” In FY 2012, the revenue results are plus or minus slightly more than two percent. Note, there is a $1.50 additional charge for non-Account-based passenger car transactions. The compensating effects with higher Account-based participation are more transactions because the effective toll rate is lower for more people but the revenue per transaction is lower. The effect is the same in reverse for a lower Account-based participation percentage. With lower participation, the revenue difference from the baseline increases in future years but is always less than seven percent. In this case, there are fewer transactions due to the higher average toll but more revenue collected due to the differential paid by Pay-by-Mail users.

MOTOR FUEL COST

A base assumption is that FY 2012 fuel costs will be $3.86 per gallon ($3.77 in 2010 dollars). A test evaluating a 50 percent increase in fuel cost results in a FY 2012 fuel cost of $5.79 ($5.66 in 2010 dollars). Fuel prices can be extremely volatile but this is a reasonable upper limit. Higher fuel prices reduce overall demand but also make additional travel distance in order to avoid a toll less attractive. Both these effects are taken into account.

The results are shown in Table 8-1 labeled “50% Higher Fuel Cost.” The results vary by year but are in the range of a four to five percent decrease in revenue. Noting that the test involves a 50 percent increase in fuel price, this test could be seen as a reasonable upper limit on what might be expected due to fuel price escalation.

TRIP SUPPRESSION AND MODE SHIFT

Among the travel parameters modeled in this study, one is the response to tolling of SR 520 users in terms of their trip-making characteristics. The tolling model sensitivity to these changes is based on the stated preference survey in terms of trips cancelled, destinations changed, trips combined together, or trips shifted to transit. These effects were incorporated in the travel model as an integral part of the assignment process. This sensitivity test determined the possible impact on revenue estimates if the actual response of travelers would be different from the model assumptions. For a test of higher suppression, a parameter in the trip suppression equation was varied to raise the number of trips suppressed. In the baseline the number of trips suppressed ranged from about three percent of toll-free demand in FY 2031, to 4.3 percent in FY 2017, and four percent in FY 2012. The higher suppression test used a suppression of 6.9 percent in FY 2031, 10.1 percent in FY 2017, and 10.2 percent in FY 2012. In the other suppression test, suppression was eliminated completely. In considering whether a higher suppression upper limit test would be reasonable, the high test is compared to the Tacoma Narrows Bridge experience in Chapter 7 under Estimated Daily Traffic & Revenue. In essence, that situation was more prone to suppression than the SR 520 case; the suppression there was about six percent.

The results of the test are shown in Table 8-1 labeled "Higher Suppression" and "No Suppression." The results indicate relatively modest revenue impacts with higher suppression in FY 2012 lowering revenue by 3.4 percent and no suppression increasing revenue by 4.1 percent. The effects in outer years are less. Thus, with the range tested, suppression is not an important consideration

POSSIBLE TOLLING OF THE I-90 BRIDGE

This sensitivity test illustrated how implementation of tolls on the I-90 bridge over Lake Washington would have a positive impact on SR 520 toll revenue. The I-90 bridge is the principal alternative to the SR 520 bridge so tolling it reduces the possible diversion of trips off of SR 520. It was assumed that all traffic on I-90 would be subject to the same toll as on SR 520 for each hour and day of the week. Note that this test only determines the additional revenue from SR 520 tolling because of the tolling on I-90. The toll revenue generated on I-90 is not included in the revenue estimates herein.

The results are shown in Table 8-1 labeled as "I-90 Tolled." As expected, the tolling of I-90 will have substantial positive benefits on SR 520 revenue particularly in the early years. For FY 2012 the increased revenue is about 38 percent declining to just under 10 percent by FY 2031.

Table 8-1
Summary of Sensitivity Test Results for Transactions and Revenue - FY 2012 and FY 2017
(Transactions in millions and revenue in millions of year of collection dollars)

FY 2012			Difference from Baseline Scenario		Percent Difference from Baseline Scenario	
Sensitivity Test	**Transactions**	**Revenue**	**Transactions**	**Revenue**	**Transactions**	**Revenue**
Baseline Scenario	**8.66**	**$27.84**				
Regional Growth:						
No Growth	n/a	n/a	n/a	n/a	n/a	n/a
Low Growth	n/a	n/a	n/a	n/a	n/a	n/a
High Growth	n/a	n/a	n/a	n/a	n/a	n/a
Value of Time (VOT):						
20% Higher VOT	9.31	30.13	0.65	$2.29	7.5%	8.2%
20% Lower VOT	7.78	24.71	-0.88	-3.13	-10.1%	-11.2%
Account-based Participation Rate:						
20% Higher Account-based	8.92	27.21	0.26	-0.63	3.0%	-2.2%
20% Lower Account-based	8.41	28.52	-0.25	0.68	-2.9%	2.4%
Motor Fuel Cost:						
50% Higher Fuel Cost	8.31	26.65	-0.35	-1.19	-4.0%	-4.3%
Trip Suppression and Mode Shift:						
Higher Suppression	8.37	26.88	-0.29	-0.96	-3.4%	-3.4%
No Suppression	9.02	28.98	0.36	1.14	4.1%	4.1%
Possible Tolling of I-90 Bridge:						
I-90 Tolled*	11.89	38.44	3.23	10.60	37.3%	38.1%

FY 2017			Difference from Baseline Scenario		Percent Difference from Baseline Scenario	
Sensitivity Test	**Transactions**	**Revenue**	**Transactions**	**Revenue**	**Transactions**	**Revenue**
Baseline Scenario	**23.62**	**$87.64**				
Regional Growth:						
No Growth	18.87	66.54	-4.74	-$21.10	-20.1%	-24.1%
Low Growth	21.38	77.69	-2.23	-9.95	-9.5%	-11.4%
High Growth	26.37	98.97	2.75	11.33	11.6%	12.9%
Value of Time (VOT):						
20% Higher VOT	24.89	92.85	1.27	5.21	5.4%	5.9%
20% Lower VOT	21.91	80.73	-1.71	-6.91	-7.2%	-7.9%
Account-based Participation Rate:						
20% Higher Account-based	24.22	84.56	0.60	-3.08	2.5%	-3.5%
20% Lower Account-based	23.05	91.16	-0.57	3.52	-2.4%	4.0%
Motor Fuel Cost:						
50% Higher Fuel Cost	22.64	84.02	-0.98	-3.62	-4.1%	-4.1%
Trip Suppression and Mode Shift:						
Higher Suppression	23.01	85.44	-0.61	-2.20	-2.6%	-2.5%
No Suppression	24.44	90.75	0.82	3.11	3.5%	3.6%
Possible Tolling of I-90 Bridge:						
I-90 Tolled*	29.95	110.70	6.33	23.06	26.8%	26.3%

*includes impact on SR 520 revenue only

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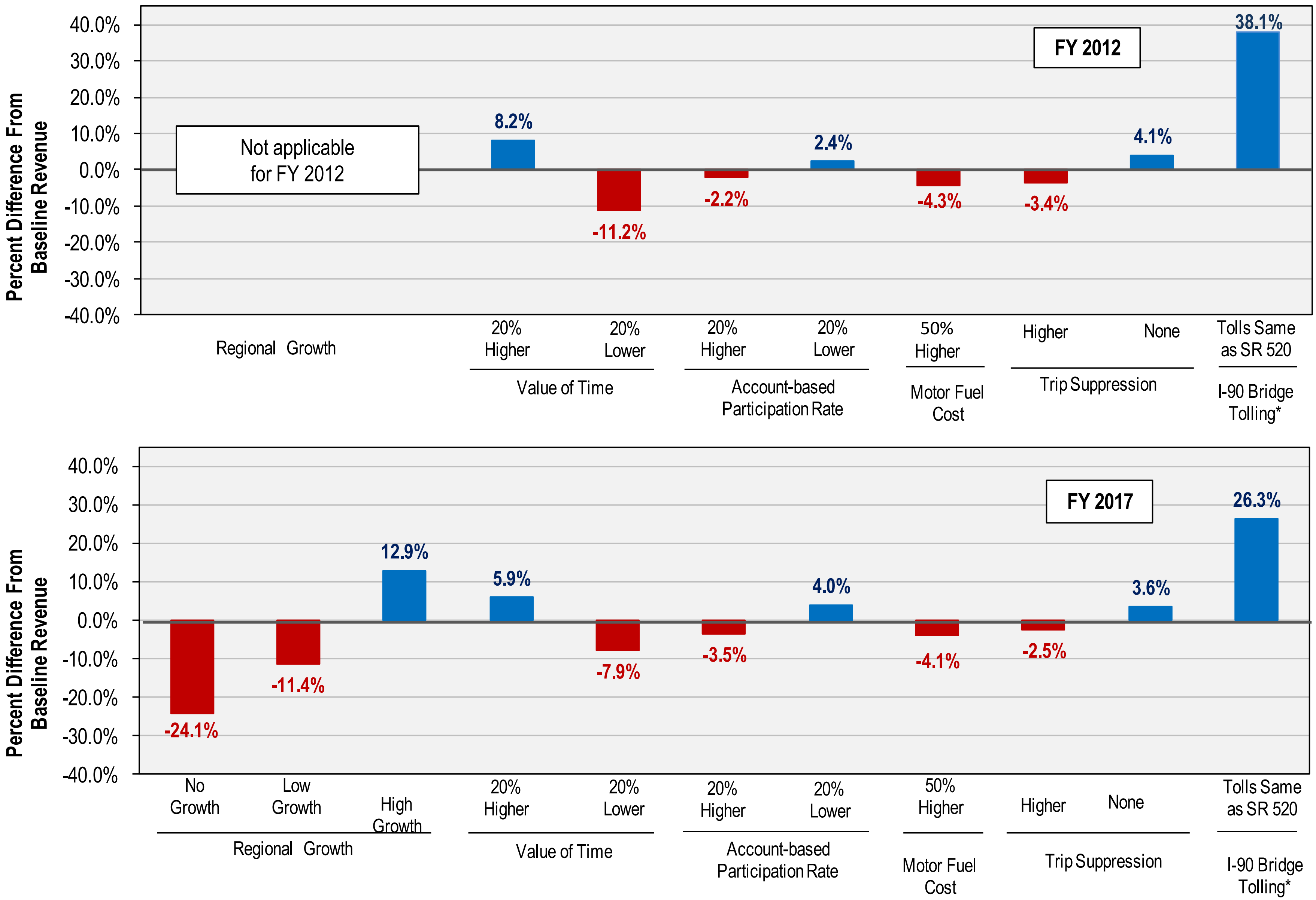
Table 8-1 (Continued from previous page)
Summary of Sensitivity Test Results for Transactions and Revenue - FY 2024 and FY 2031
(Transactions in millions and revenue in millions of year of collection dollars)

FY 2024			Difference from Baseline Scenario		Percent Difference from Baseline Scenario	
Sensitivity Test	**Transactions**	**Revenue**	**Transactions**	**Revenue**	**Transactions**	**Revenue**
Baseline Scenario	**29.62**	**$104.21**				
Regional Growth:						
No Growth	23.25	78.50	-6.37	-$25.71	-21.5%	-24.7%
Low Growth	26.50	91.74	-3.12	-12.47	-10.5%	-12.0%
High Growth	34.02	120.87	4.40	16.66	14.9%	16.0%
Value of Time (VOT):						
20% Higher VOT	30.66	108.17	1.04	3.96	3.5%	3.8%
20% Lower VOT	28.04	98.09	-1.58	-6.12	-5.3%	-5.9%
Account-based Participation Rate:						
20% Higher Account-based	30.18	98.95	0.56	-5.26	1.9%	-5.0%
20% Lower Account-based	29.02	109.55	-0.60	5.34	-2.0%	5.1%
Motor Fuel Cost:						
50% Higher Fuel Cost	28.13	98.86	-1.49	-5.35	-5.0%	-5.1%
Trip Suppression and Mode Shift:						
Higher Suppression	28.94	101.70	-0.68	-2.51	-2.3%	-2.4%
No Suppression	30.42	106.90	0.80	2.69	2.7%	2.6%
Possible Tolling of I-90 Bridge:						
I-90 Tolled*	35.31	122.94	5.69	18.73	19.2%	18.0%

FY 2031			Difference from Baseline Scenario		Percent Difference from Baseline Scenario	
Sensitivity Test	**Transactions**	**Revenue**	**Transactions**	**Revenue**	**Transactions**	**Revenue**
Baseline Scenario	**34.12**	**$120.15**				
Regional Growth:						
No Growth	25.60	85.22	-8.52	-$34.93	-25.0%	-29.1%
Low Growth	30.00	103.46	-4.12	-16.69	-12.1%	-13.9%
High Growth	39.85	141.75	5.73	21.60	16.8%	18.0%
Value of Time (VOT):						
20% Higher VOT	34.84	122.77	0.72	2.62	2.1%	2.2%
20% Lower VOT	33.02	116.09	-1.10	-4.06	-3.2%	-3.4%
Account-based Participation Rate:						
20% Higher Account-based	34.52	113.39	0.40	-6.76	1.2%	-5.6%
20% Lower Account-based	33.66	128.13	-0.46	7.98	-1.4%	6.6%
Motor Fuel Cost:						
50% Higher Fuel Cost	32.35	113.77	-1.77	-6.38	-5.2%	-5.3%
Trip Suppression and Mode Shift:						
Higher Suppression	33.66	118.58	-0.46	-1.57	-1.4%	-1.3%
No Suppression	34.85	122.53	0.73	2.38	2.1%	2.0%
Possible Tolling of I-90 Bridge:						
I-90 Tolled*	38.18	131.69	4.06	11.54	11.9%	9.6%

*includes impact on SR 520 revenue only



* Includes impact on SR 520 revenue only

SENSITIVITY TESTS RESULTS

FIGURE 8-1

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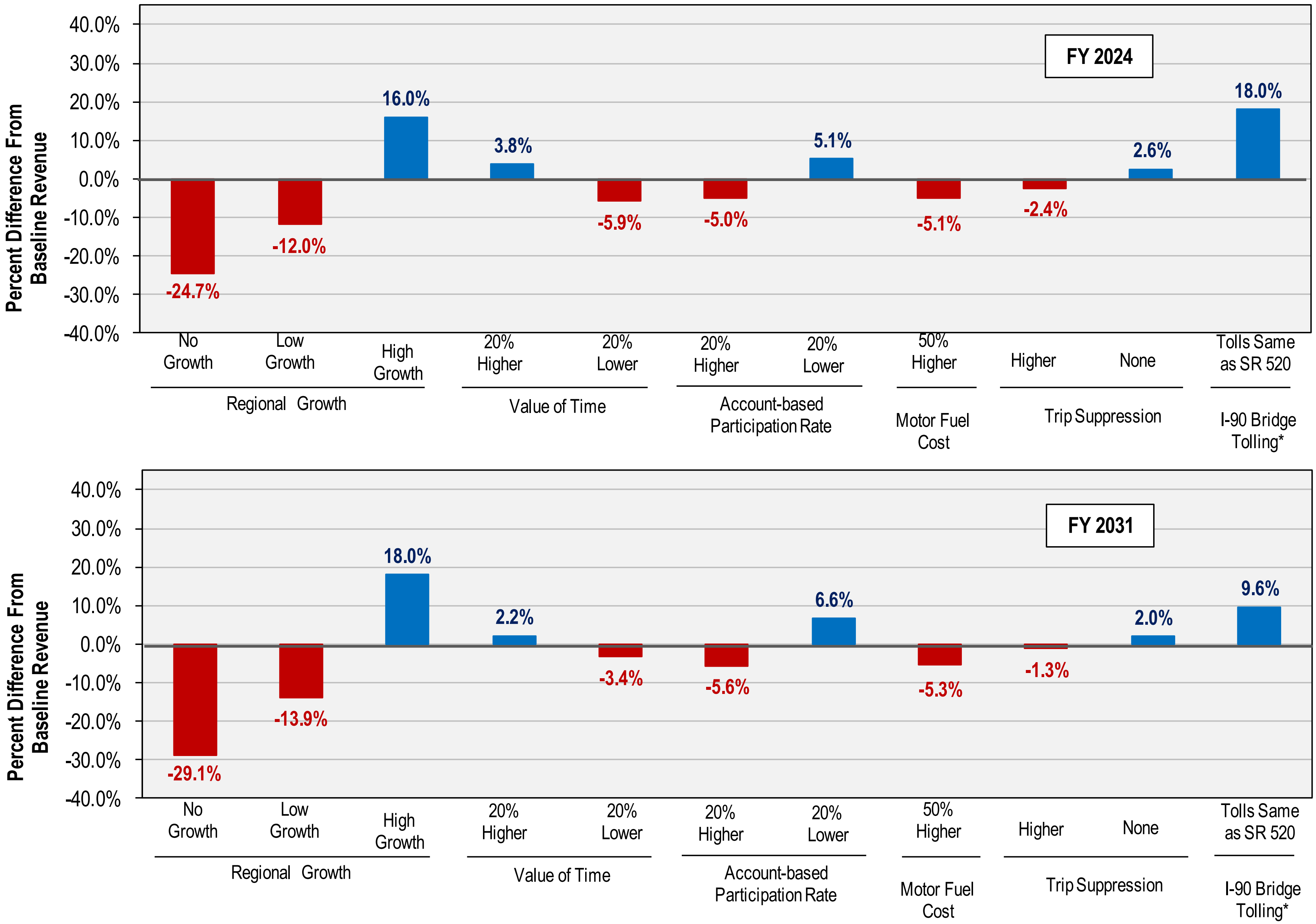

* Includes impact on SR 520 revenue only

SENSITIVITY TESTS RESULTS

FIGURE 8-1 Continued from previous page…

Disclaimer:

Current accepted professional practices and procedures were used in the development of these traffic and revenue forecasts. However, as with any forecast of the future, it should be understood that there may be differences between forecasted and actual results caused by events and circumstances beyond the control of the forecasters. In formulating its forecasts, WSA has reasonably relied upon the accuracy and completeness of all of the information provided (both written and oral) by respective local and state agencies. Publicly available and obtained material has neither been independently verified, nor does WSA assume responsibility for verifying such information. WSA has relied upon the reasonable assurances of the independent parties that they are not aware of any facts that would make such information misleading.

WSA has made qualitative judgments related to several key variables within the analysis used to develop the traffic and revenue forecasts that must be considered as a whole; therefore selecting portions of any individual results without consideration of the intent of the whole may create a misleading or incomplete view of the results and the underlying methodologies used to obtain the results. WSA gives no opinion as to the value or merit to partial information extracted from the report.

All estimates and projections reported herein are based on WSA's experience and judgment and on a review of independent third party projections and information obtained from multiple state and local agencies. These estimates and projections may not be indicative of actual or future values, and are therefore subject to substantial uncertainty. Future developments cannot be predicted with certainty, and may affect the estimates or projections expressed in the report, such that WSA does not specifically guarantee or warrant any estimate or projections contained within this report.

While WSA believes that some of the projections or other forward-looking statements contained within the report are based on reasonable assumptions as of the date in the report, such forward looking statements involve risks and uncertainties that may cause actual results to differ materially from the results predicted. Therefore, following the date of this report, WSA will take no responsibility or assume any obligation to advise of changes that may affect its assumptions contained within the report, as they pertain to: socioeconomic and demographic forecasts, proposed residential or commercial land use development project, and/or potential improvements to the regional transportation network.